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SELECTED ECONOMIC TRANSLATIONS ON EASTERN EUROPE

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SELECTED ECONOMIC TRANSLATIONS ON EASTERN EUROPE

INTRODUCTION

This is a serial publication containing selected translations on all categories of economic subjects and on geography. This report contains translations on subjects listed in the table of contents below. The translations are arranged alphabetically by country.

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BULGARIA

Bibliography of the Most Important Works and Articles on Bulgarian Geography Published in Bulgaria in 1944-1959 (Part 1)

[This is a translation of a bibliography, compiled by Lyubomir Dinev, in Geografiya, Vol IX, No 9, August 1959, pages 23-24; CSO: 3357-N/a]

Abbreviations

G - Geografiya; Geography

GPr - Geografski Pregled; Geographic Review

GSUBGGF-t - Godishnik na Sofiyskiya Universitet--Biologo-geologo-georafski fakultet; Yearbook of the Sofia University--Department of Biology-Geology-Geography

GSUIst-fil-f-t--Godishnik na Sofiyskiya Durzhaven Universitet--Istoriko-filologicheski fakultet; Yearbook of the Sofia State University--Department of History and Philology

GVFSI - Godishnik na Visshiya finansovo-stopanski Institut Svishtov; Yearbook of the Higher Financial-Economic Institute of Svishtov

IzvBGD - Izvestiya na Bulgarskoto Geografsko Druzhestvo; News of the Bulgarian Geographic Society

IzvGIBAN - Izvestiya na Geografskiya Institut pri Bulgarskata Akademiya na Naukite; News of the Geographic Institute at the Bulgarian Academy of Sciences

IG - Istoriya i Geografiya; History and Geography

IkM - Ikonomicheska Misul; Economic Thought

NArkh - Narodno-stopanski arkhiv; National-Economic Archive

NVr	-	<u>Novo Vreme</u>; New Times
NPr	-	<u>Narodna Prosveta</u>; Public Education
OGB	-	Osnovi za Geologiyata na Bulgariya; Bases for Bulgaria's Geology
Pr	-	<u>Priroda</u>; Nature
Sb Beshkov	-	Sbornik v chest na akad. A. S. Beshkov; Collection in Honor of Academician A. S. Beshkov
T	-	<u>Turist</u>; Tourist
UchPr	-	<u>Uchilishten Pregled</u>; School Review
KhrPr	-	<u>Khranitelna Promishlenost</u>; Food Industry

* * *

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BULGARIA

The Weather in Bulgaria in 1958

[This is a translation of an article by Dimitur Y. Dimitrov in Geografiya, Vol IX, No 8, August 1959, Sofia, pages 5-8; CSO: 3357-N/b]

The weather in Bulgaria during 1958 had three major distinguishing features: mild winter, hot summer, and very little precipitation over a six- to eight-month period. Thus the past year can be classified as quite unusually climatically.

It is known that Bulgaria has also had warm winters, prolonged dry periods, and hot summers in the past. Seldom, however, have these three features been observed during the same year. Therefore, it is interesting to discuss the figures on some of the most important climatic elements during this year.

In analyzing the 1958 temperature curve, we see that during the months of January and February it lies above the curve of the average temperature. Furthermore, the minimal absolute temperatures are very high compared to the minimal absolute temperatures observed in the course of the climatic period at the weather stations involved. Thus, for example, during January 1958 the lowest absolute temperature was only -18 degrees in Trun compared to -38.3 degrees (1947) and - 38 degrees (1942); -9.2 degrees in Knezha compared to -35.5 degrees (1942); -8.2 degrees in Varna compared to -23.5 degrees (1942); -5.8 degrees in Plovdiv compared to -31.5 degrees; -5 degrees in Sanduski compared to -18.7 degrees, and so on. The picture is similar during the month of February as well: Trun, -13.2 compared to -30.2; Knezha, -6.3 compared to -30; Varna, -2.7 compared to -24.3; Plovdiv, -6.9 compared to -29.1; Sandanski, -4.6 compared to -15.6, etc. Even during the month of March, which in general was a cold month, the observed minimal absolute temperatures are higher than the extreme minimal temperatures of that month.

The analysis of the absolute maximal temperatures also gives some indication of the thermic regime during the winter months. The results of such comparisons, however, are not as significant as those of the absolute minimal temperature.

The average figures of the maximal temperatures give better indications. Such data, however, cannot be given because of the lack of processed material. This also refers to the average monthly temperatures.

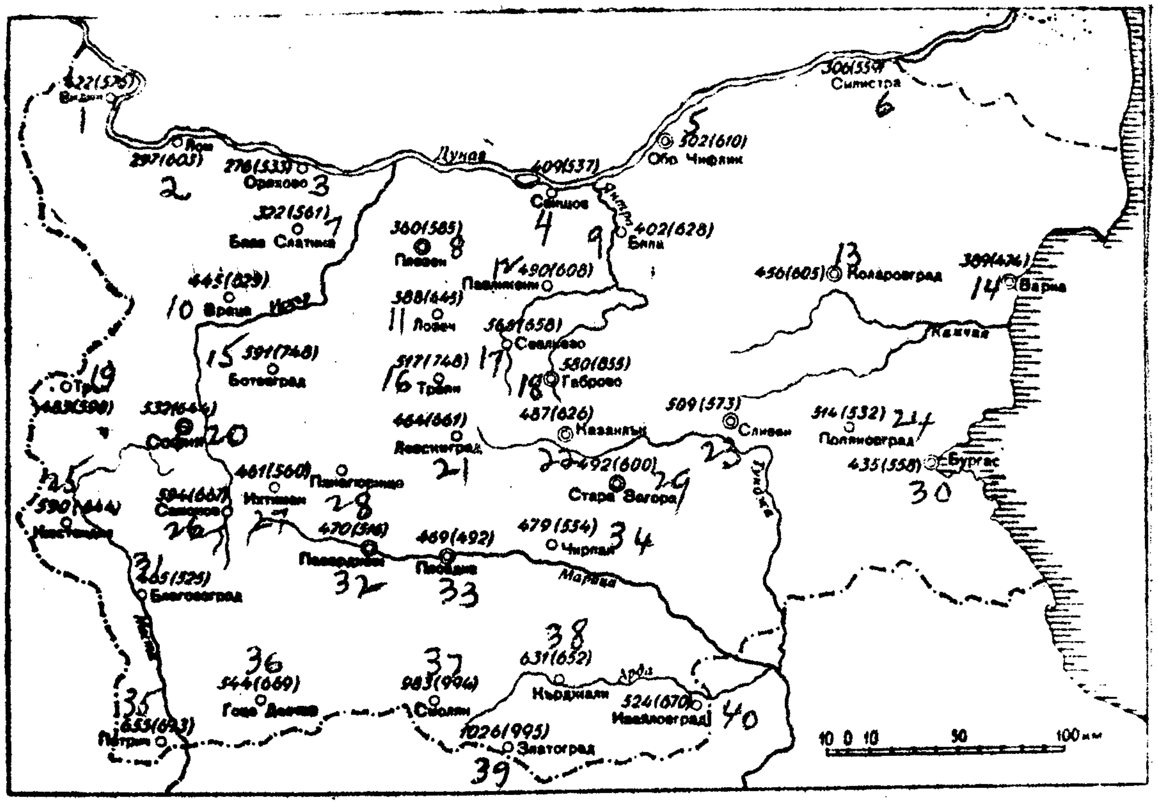
The second characteristic period in terms of temperature is the summer. Generally, it had great and prolonged hot spells. Unfortunately, the lack of processed material makes it impossible to give the average data for the highest temperatures as well as data for the average temperatures of the summer months. We will give data only for the extreme maximal temperatures.

Unlike those of the winter months, the highest temperatures for the summer period are more indicative. Therefore, the data given for the highest absolute temperatures do actually prove the existence of great hot spells.

The hot spells in question extended over almost all of the country's territory. As usual, however, they had their "preferred" regions. It is true that the highest summer temperatures last year were not record highs (compared to other hot summer months); however, the hot spells were very long. Combined with the lack of precipitation, they dustry air, and the faded vegetations, they gave the illusion of being something quite unusual.

The highest temperature in 1958 was observed in the town of Kharmanli (42 degrees). Close to it were the maximal temperatures in Elkhovo, Polyanovgrad, Kurdzhali, Peshtera, Ruse, Kolarovgrad, Sandanski, Petrich, and others (between 41 and 42 degrees in the shade). Nowhere, however, was the highest absolute temperature of the country reached (45.2 degrees)--observed during the month of July 1916 in Sadovo not the 45 degrees observed during that same period in Grvril Genov (Minkova Makhala) and Vurshets.

The peculiarities of the climate during the course of 1958 are even more evident when the precipiation is analyzed. Comparing in the simplest manner the precipitation totals of 1958 with the average precipitation for a 50-year period, it is clear that during the past year [1958] the precipitation total were much lower. This difference is as much 20 to 50 percent in northern Bulgaria and the Black Sea coast notth of Burgas, the sub-Balkan plains, the region of Sandanski-Petrich, and the high-mountain regions of Stara-Planina, Vitosha, and Rila. The greatest deviations are noted in the



Total annual precipitation in Bulgaria during 1958 (figures in parentheses are averages for the 1896-1945 period [in millimeters]). Data from the Climate Archives of the Hydro-meteorological Bureau.

1) Vidin
2) Lom
3) Oryakhovo
4) Svishtov
5) Obraztsov Chiflik
6) Silistra
7) Byala Slatina
8) Pleven
9) Byala
10) Vratsa
11) Lovech
12) Pavlikeni
13) Kolarovgrad
14) Varna
15) Botevgrad
16) Troyan
17) Sevlievo
18) Gabrovo
19) Trun
20) Sofia
21) Levskigrad
22) Kazanluk
23) Sliven
24) Polyanovgrad
25) Kyustendil
26) Samokov
27) Ikhtiman
28) Panagyurishte
29) Stara Zagora
30) Burgas
31) Blagoevgrad
32) Pazarkzhik
33) Plovdiv
34) Chirpan
35) Petrich
36) Gotse Delchev
37) Smolyan
38) Kurdzhali
39) Zlatograd
40) Ivaylovgrad

region of Lom--297 millimeters of annual precipitation (normal precipitation, 603 millimeters), Oryakhovo--276 millimeters (533), Byala Slatina--322 millimeters (561), Vratsa--445 millimeters (829), Pleven--360 millimeters (535), and so on. Only in Zlatograd was the annual precipitation higher than the normal yearly total: 1,026 millimeters (compared to 994 millimeters of normal precipitation).

Of particular interest is the amount of precipitation during the vegetative period of most of the crops cultivated in Bulgaria. We must, however, point out in advance that the drought during this period followed dufferent patterns in the different parts of the country. Thus, for example, in some localities it started as early as the month of April (Lom, Byala Slatina, Oryakhovo), and during May in others (Vidin, Vratsa, Gabrovo, Lovech, Pleven, Svishtov, Pavlikeni, Byala, Obraztsov Chiflik, Silistra, and Tervel in northern Bulgaria; and Plovdiv, Pasardzhik, Kazanluk, Panagyurishte, Ikhtiman, and Sofia in central Bulgaria). The dry period which started in May also extended to the region of the middle course of the Struma River (Blagoevgrad, Sandanski, Petrich).

June normally has the highest monthly precipitation in the country (excluding the most southern regions). During the year discussed, however, the precipitation for this month was far below average in many places (Vidin, Lom, Boychinovtsi, Oryakhovo, Pleven, Sofia, Trun, Petrich, G. Delchev, and others.) There are other regions, however, where the dry spell was broken temporarily and considerably more precipitation was registered (Troyan, Gabrovo, Sevlievo, Svishtov, Pavlikeni, Gorna Oryakhovitsa, Obraztsov Chiflik, Tervel, Elkhovo, Stara Zagora, Kazanluk, Plovdiv, Pazardzhik, Kurdzhali, Zlatograd, and others). This break in the drought had quite a favorable effect on some of the crops in the above-mentioned regions.

The following three months (July, August, and September), which usually have less precipitation and severe hot speels (particularly in July and August), had very little precipitation during 1958. This fact, combined with the extended periods of high temperature, made the impact of the drought even more severe. The dryness was felt very actuely in the regions of Vidin, Lom, Byala Slatina, Oryakhovo, Lovech, Pleven, Pavlikeni, Byala, Silistra, Tervel, Kolarovgrad, Varna, Burgas, Polyanovgrad, Elkhovo, Plovdiv, Pazardzhik, Krumovgrad, Sliven, Kazanluk, Levskigrad, Pirdop, Ikhtiman, Blagoevgrad, and others.

Table 1

Monthly Precipitation in Bulgaria during 1958, by Regions

Meteorological Stations	Months 1	2	3	4	5	6	7	8	9	10	11	12	Total for Year	Normal Yearly Total
Temperate Continental Region														
Vidin	32	3	75	99	38	25	2	13	30	50	37	18	422	576
Pleven	49	9	47	52	34	28	18	9	17	72	16	9	360	585
Obraztsov Chiflik	84	7	52	117	18	80	49	19	26	31	11	8	502	610
Silistra	55	11	37	55	12	52	32	2	14	23	10	3	306	559
Sofia	58	26	72	104	31	41	40	15	53	52	26	14	532	644
Transitional Continental Region														
Stara Zagora	70	8	54	98	50	75	46	19	10	25	37	2	492	600
Levskigrad	60	2	63	110	40	77	31	5	15	33	21	7	464	661
Kyustendil	78	21	139	99	58	44	14	50	37	18	14	18	590	644
Plovdiv	64	0	64	92	37	109	7	4	40	29	20	3	469	492
Transition Mediterranean Region														
Petrich	202	34	119	72	12	35	30	8	44	32	42	25	655	693
G. Delchev	124	30	120	56	7	28	20	41	40	30	40	8	544	669
Kurdzhali	120	6	85	90	40	102	32	6	32	44	67	7	631	652
Black Sea Region														
Varna	35	12	49	64	49	68	36	0	6	45	12	13	389	474
Burgas	54	22	46	83	55	41	24	6	22	39	16	27	435	558
Mountainous Region														
Stalin Peak	57	28	169	104	106	82	47	53	28	37	50	35	796	1,193
Cherni Vrukh Peak	80	29	188	121	82	72	80	53	51	55	38	30	879	1,182
Petrokhan	58	24	122	133	91	116	33	34	81	61	44	40	837	1,079

The mentioned precipitation scarcity and the protracted period of sunny days and high temperature caused the severe shortage of soil and atmospheric humidity and therefore made it necessary to irrigate almost all the crops growing at that time artificially. The damage caused by the drought was considerable because artificial irrigation was not possible in all regions involved.

The drought also affected many water sources and thereby drastically reduced or even completely exhausted them. This, combined with the insufficient pasturage for cattle, created another difficulty--shortage of water and pasturage for domestic animals.

As can be seen from the compiled data, the drought during 1958 continued until the end of the year with few exceptions, and in many places it extended through the first quarter of 1959, and thus the winter was almost without snowfall.

If we try to divide Bulgaria into regions according to the effect of the drought, we see that the drought affected the entire territory, regardless of the fact that in some regions the annual precipitation did not differ much from the average multi-annual precipitation of the same climatic region. This is explained by the fact that in some of these places winter precipitation has been greater and thus offset the scarce precipitation of the hot six-month period (regions with a transitional Mediterranean climate), or that during some of the summer months the precipitation was heavier and thus also increased the yearly precipitation. If we exclude, however, the most important regions of our territory where summer droughts occur almost every year, the drought during the vegetative period of 1958 was felt the most in northern Bulgaria and the western highland part of central Bulgaria. The drought was not felt as acutely in the Upper Thracian Plain, mainly because of the greater June precipitation. Furthermore, in this case the dryness could also be considered, in another sense, as a regular--although somewhat more pronounced--expression of summer dryness.

BULGARIA

The Batak Water-Power System

[This is a translation of an article by Iliya Nede-kov, in Elektroenergiya, Vol X, No 8/9, August-September 1959, Sofia, pages 3-10; CSO: 3424-N]

On the even of the fifteenth year of the Bulgarian Socialist Revolution, the largest and most complex water power system in Bulgaria--the Batak--was opened with a ceremony and put into exploitation.

The basic aim of this system is to use the run-off from the Rhodopi Massif, with the aid of numerous water-capturing dams, to divert even the smallest mountain stream into collecting channels and water-power lakes for the production of electric power and for irrigation.

In order to achieve this aim, 175 water reservoirs have been built into the whole system for water 5 l [liters?] or 4 cubic meters per second, 125 kilometers of channels for water from 0.10 to 15 cubic meters per second, four water reservoir walls, two underground, and one above-ground power station, three step-up substations for 110 and 220 kilowatts, one central coordinating substation, three electric cables for transporting the power to the coordinating substation, two pumping stations, and two electric cables for 20 kilowatts for supplying the pumping stations.

The Batak water power system is developing around the two main reservoirs, the "V. Kolarov" and the "Batak," on the level of which are built both water-collecting channels.

The upper belt is made of the "Beglika," "Gashnya," "Byala," and "Cherna" channels, whose waters flow gravitationally into the V. Kolarov reservoir--either directly into the reservoir or via the main tunnel of the "Batak" VETs [hydroelectric power station]. To the same belt can be added the subsidiary reservoirs, the "Beglika" and the "Toshkov Chark," whose waters, via pumping stations, are transferred via the main derivation tunnel of the "Batak" VETs and also in the "V. Kolarov" reservoir.

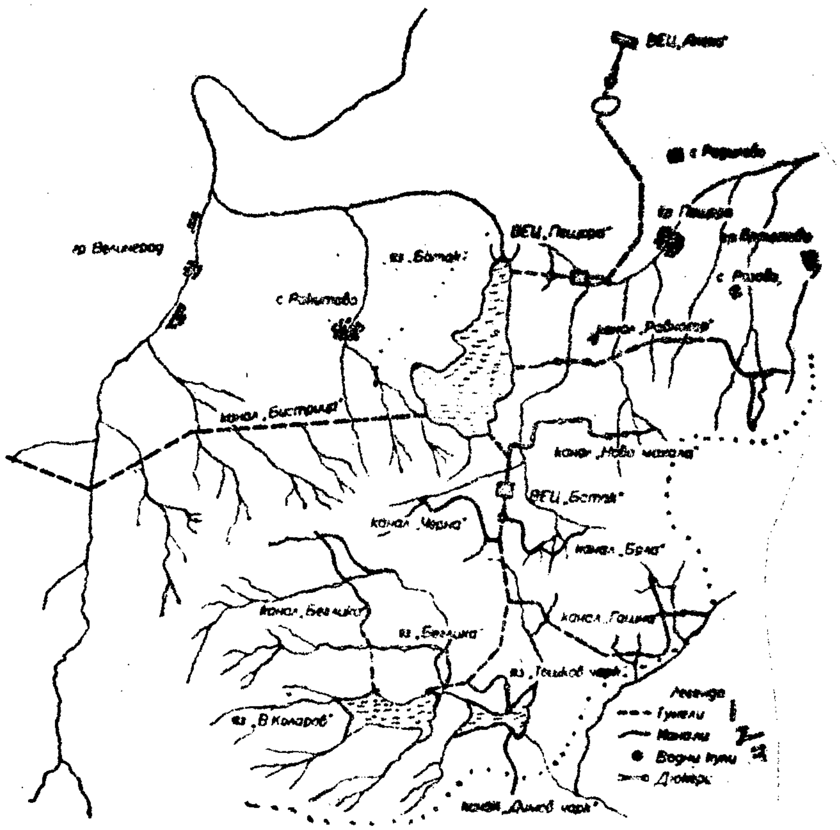


Figure 1

Map of the Batak Water Power System

1) Tunnels
2) Canals
3) Water towers
4) Siphons

The lower belt is made from the "Bistritsa," "Ravnogor," and "Nova Mahal" channels, and the collecting channels around "Saint Constantine."

The waters collected in the "V. Kolarov" reservoir are used by the "Batak" power station and those in the "Batak" reservoir are used in the "Peshtera" and "Aleko" power stations. Roughly, the drop between the "V. Kolarov" reservoir and the "Batak" reservoir is 421 meters, and that from the "Batak" reservoir to the beginning of the irrigation canal under the "Aleko" VETs is 875 meters.

The Batak water power system collects its waters in a region containing parts of the Vi'cha, Elivere, and Stara Rivers--a total of 7,736 square kilometers, at elevations from 500 to

2,100 meters above sea level. From a climatic point of view, this region is almost totally under the influence of the continental climate and only the Devinska River is subject periodically to Mediterranean influences. The average annual precipitation is from 700 to 900 millimeters and is the major source of run-off.

From a geological point of view, the area of the Batak water power system is made of Paleozoic crystalline schists, intrusive rocks, volcanics, Paleogene and Neogene Tertiary sediments and Quaternary sediments.

The major reservoirs, "V. Kolarov" and "Batak," annually and multi-annually regulate the run-off which allows the "Batak" VETs to work entirely as an upper water power station. The daily regulators under the "Peshtera" and "Aleko" VETs allow both stations to work during the irrigation season 48 hours according to an energy schedule. Nevertheless, they can be used at their optimum only during the irrigation period, in which only a third of the water is drained from the "Batak" reservoir, as at present there is no large reservoir under the "Aleko" VETs.

The First Step of the System

This incorporates the "Batak" VETs with the "V. Kolarov" reservoir, the additional reservoirs of "Beglika" and "Toshkov Chark," and the pumping stations bearing the same names, and the "Beglika," "Gashnya," "Byala," and "Cherna" water-absorbing canals. From the "V. Kolarov" reservoir the main derivative irrigation channel starts and takes the water, via an underwater pressurized pipe, to the underground "Batak" VETs, from which, via an underground lower channel, the water enters the "Batak" reservoir.

The V. Kolarov, Beglika, and Toshkov Chark Reservoirs and Collecting Channels from the Upper Belt

The "V. Kolarov" reservoir has a volume of 65 million cubic meters and is built on the Kriva River in the Tachboaz Narrows. Its wall has a trapeze profile, 68.3 meters at the base and 8 meters at the top. The slope for the water drop is 1:0.7 and the opposide side is 1:1 and 1:0.7. The wall is made from large rhyolite blocks with flexible condesnation material

made up of a number of layers for prevention of leakage. Along the entire length of the wall, as well as in the slopes next to the reservoir walls, vast injection works were built with a cement solution.

The spillway for 50 cubic meters per second is inclined, and the length of the spillway edge is 60 meters, with two major outflows made of iron pipes, 120 centimeters in diameter, freely placed in special galleries and isolated from the water side. The shutters (working and safety ones) are at the end of the pipes in a special building at the foot of the dam wall.

Beglika Collecting Canal: Its total length[1] is 7,695 meters, and it takes water from the main tributaries of the Beglika-Karachumak, Suisuza, and Semiza Rivers, taking it gravitationally to the V. Kolarov reservoir.

Beglike Reservoir and Pumping Station: These are built on the Beglika River, 0.5 kilometers from the dam wall of the V. Kolarov reservoir. The wall is massive, made of concrete, with slopes on the water side of 1:0.05 and on the opposite side of 1:0.7. The reservoir has its level 32 meters under the V. Kolarov reservoir, and level the outflow of the Belika River. Via a pumping station made at the foot of the dam wall, the collected waters are pressurized into the derivation channel of the "Batak" VETs, which in this locality crosses the valley of the stream. The pump, for 750 liters per second and a height of 40 meters, is worked by an electric generator of 380 kilowatts.

"Toshkov Chark" Reservoir and Pumping Station: The wall of the reservoir is built on the Damlu'dere River, immediately beyond the confluence of the Beglika and Selkyupriya Rivers, 106 meters under the level of the V. Kolarov reservoir. The wall is made of large rhyolite blocks, shielded with steel foil 6 millimeters thick laid on concrete 0.6 meters thick. The slope from the water side is 1:0.7, and on the other side 1:0.4, 1:0.8, and 1:1. The overflow is inclined for [a flow of] 173 cubic meters per second. The main outflow for 2.5 cubic meters per second is a steel pipe 60 centimeters in diameter.

The pumping station is built on the right shore of the reservoir. This station pumps the waters from the reservoir via steel pipes one meter in diameter and 395 meters long into a canal, the "Toshkov Chark," 205 meters long, with a slope of 1:1,000, from where they are taken gravitationally via the

sloping window--I--in the major derivation tunnels of the "Batak" VETs. The pump is constructed for 1.5 cubic meters per second, has two single-step centrifugal pumps of the V-165 type, each for 750 liters per second and 130 meters high, made by the Andritz Company in Austria. The pumps are worked by two vertical three-phase generators made by Garbe-Lamia, Aachen, type AV 15/121, 6 kilovolts, with a power of 1,300 kilowatts and 1,485 revolutions per minute. The pumps are located in a dry gallery 7 meters in diameter and 14 meters deep, dug into the rock by the shore, while the electric generators are in a machine room placed above the highest water level of the reservoir.

The "Dimov Chark Collecting Canal: Its total length is 3,453 meters; it takes water from the right tributaries of the Damlu'dere River and gravitationally sends it to the "Toshkov Chark" reservoir.

Gashnya Collecting Channel: This channel takes water from the left tributaries of the Damlu'dere River: Gashnya, Makhalite, Karlu'shka, Chokura, and others. Gravitational window III takes it to the main derivation tunnel of the "Batak" VETs. The total length, including the lateral canal, is 13,470 meters.

The "Byala" Collecting Canal: With a total length of 6,618 meters, this canal takes water from the Byla River and gravitationally supplies it to the "Batak" VETs via a water tower.

"Cherna" Collecting Canal: With a total length of 10,761 meters, this canal takes water from the Cherna and Semeralan Rivers and their tributaries--whose sources are in the northern slopes of "Kartu'la"--and gravitationally, via window IV, supplies the "Batak" VETs. Water is captured in the pressure tunnel through window IV via a steel tube 70 centimeters in diameter, with two branches 50 and 60 centim ters in diameter and 668 meters in total length, with a drop of 70 meters.

Batak Hydroelectric Station

The pressure tunnel of the "Batak" VETs begins from the V. Kolarov dam, taking in water from the left shore of the

reservoir, where it is covered with a grid and provided with a shutter of the "Vegital" type. It appears again in the valley of the Beglika River and crosses the latter through a steel tube which is provided with a second cutoff 2.20 meters in diameter, ending up at the water tower. The tunnel is 11,772 meters long, cylindrical, 2.40 meters in diameter, with a two-layer facing--one concrete ring 0.20 to 0.70 meters thick and the other of steel 7 centimeters thick. To make the facing a solution of cement and sand and cement "milk" [grout?] was injected at a depth of 1.5 meters.

The water tower is built underground 131 meters from the apparatus chamber, with a vertical shaft 3.1 meters in diameter and 100 meters high, consisting of a lower chamber--a tunnel 25 meters long, and an upper chamber [with] a cylindrical widening 10 meters in diameter and 4.5 meters high.

The underground pressure tubing begins from the water tower and ends at the turbines of the underground station. The space between the water tower and the apparatus chamber (131 meters with a slope of 7.6 percent) is filled with concrete and steel facing, as well as the pressure tunnel 2.4 meters in diameter. The sector from the apparatus chamber to the branching segment (1,235 meters long and sloping 25.6 percent) is filled with steel and concrete. The steel pipe is of equal diameter, 2.3 meters, and is 12 to 26 millimeters thick. The space between the rock and the steel pipe (50 centimeters) is filled with concrete. The distributor is also underground and has four branches (0.8 meters in diameter) for each turbine. In the (underground) apparatus chamber, two valves 2 meters in diameter are built to safeguard the pipe. One of them has an automatically functioning oil-pressure system, while the other (emergency) has a manual cutoff. When necessary, the cutoff can be closed electrically from the coordination room in the station. The cutoffs are constructed one after the other, and two air valves are installed on the pipe which joins them.

At the end of the pipe and the branching segment before the turbine there is an underground room in which two cutoffs are located--two for each turbine: one with an oil-pressure mechanism and automatic control connected to the central automatic control of the station, and the other (emergency) with manual closing.

Table 1

Basic Data for Derivative and Collecting Canals

Step	Collecting Canal or Derivative	Tunnels: Amount	Tunnels: Longest Sector in Meters	Tunnels: Total Length in Meters	Canals in Meters	Siphon in Meters	Water Capturing Capacity	Water-Capturing Region in 1,000 m^2	Water Captured in Million m3	Used Water Fall in Meters	Dammed Water m3/sec
Batak I VETs	V. Kolarov Dam	—	—	—	—	—	—	64,50	32,15	1295	—
	Beglika Dam	—	—	—	—	—	—	24,74	8,90	1263	—
	Beglika	5	1630	2530	5070	95	5	59,00	32,66	1295	3,50
	Dimov Chark	—	—	—	3453	—	4	31,50	22,20	1165	0,40
	Toshkov Chark	—	—	—	2052	—	—	—	—	—	1,70
	Gashnya	4	1550	2543	10580	347	23	53,78	29,19	1295	3,80
	Cherna	—	—	—	10093	668	25	11,28	5,65	1295	0,84
	Byala	—	—	—	6618	—	23	4,59	2,45	1295	0,32
	Major derivatives	6	3743	11772	—	—	—	—	—	—	13,60
	Windows	5	245	1074	—	—	—	—	—	—	—
	Pressure pipes	1	—	1366	—	—	—	—	—	—	13,60
	Entrances	2	—	604	—	—	—	—	—	—	—
	Lower canal	2	—	2930	—	—	—	—	—	—	13,60
	Total	25	—	22819	37866	1119	80	249,39	133,10	—	—
Peshtera II VETs	Batak reservoir	1	285[2]	285	—	—	—	86,60	24,50	875	90,00
	Bistritsa	11	3378	23904	9165	473	21	244,48	104,10	875	15,00
	Ravnogar	5	2196	6692	15833	1555	19	78,85	27,85	875	3,96
	Nova Mahkla	—	—	—	11374	847	28	41,40	15,61	875	2,76
	St. Constantine	—	—	—	15060	—	25	12,43	3,54	875	—
	Pressure tunnel	1	2988	2988	—	—	—	—	—	—	26,60
	Pressure pipe	3	502	1374	—	—	—	—	—	—	26,60
	Lower canal	2	12o3	1540	—	—	—	—	—	—	26,60
	Entrances	4	190	500	—	—	—	—	—	—	—
	Windows	2	482	918	—	—	—	—	—	—	—
	Total	28	—	38201	51432	2875	93	459,91	175,50	—	—
Aleko III VETs	Major derivatives	5	2807	9912	—	—	2	64,20	16,61	283	28,00
	Windows	3	274	603	—	—	—	—	—	—	—
	Derivative[4]	1	—	295	390	—	—	—	—	—	30,00
	Pressure tubing	2	504	675	—	603[3]	—	—	—	—	30,00
	Speed flow	—	—	—	2264	—	—	—	—	—	28,00
	Total	11	—	11485	2654	603[3]	2	64,20	16,61	—	—
	Grand total	64	—	72505	92952	4597	175	773,60	325,21	—	—

[1]The water-collecting region of the Dimov Chark canal is given together with that of Toshkov Chark reservoir.

[2]Major outflow. [3]Open steel pressure pipe. [4]Low-pressure.

The machine room, which contains the four aggregates, is located underground in a cave, with dimensions 50 x 30 x 12 meters. The power station is reached via a tunnel with an 8-percent slope, 470 meters long, and on two levels. The lower level is used for an entrance, while the upper one is for transmitting the power to the surface substation via four tri-aluminum belts. The second tunnel, 200 meters long, with a 50-percent drop, is used for ventilation. Its dimensions are 1.80 x 3.50 meters, and its height is subdivided into two galleries--one for the warm and the other for the cold air. The machine room is divided in height into five levels, for ventilation, control, generator, turbine, and drainage.

Each of the four aggregates is made of vertical turbines of the Pelton type. The turbines are made by Foint in Austria; [specifications:] 428 revolutions per minute, optimum 810 revolutions per minute; 3.40 cubic meters per second above the water; maximim drop of 410 meters; 16,300 horsepower.

The generators are vertical, synchronized, with a power of 12,500 kilovolt amperes Cos φ = 0.80, frequency 50 kilocycles, pressure 10,500 $\pm$ 5 percent, of Soviet make. The control of the turbines and generators is totally automatic, controlled in the control room and the machine room. The control office and the open-air step-up substation are at the entrance of the tunnel. In the building are located the distributing apparatuses of 10 and 20 kilovolts, the transformers, the telephone center, batteries for reserve illumination, administration offices, etc.

The electrical scheme of the station (Figure 2) shows the following: three of the generators are joined with common collecting belts of 10 kilovolts, to which are hooked up one traffic group of four single-phase transformers (one of them for reserve) with a total power of 40.5 megavolt amperes, 10.5/100 kilovolts, that feed the belts of 110 kilovolts and the 110-kilovolt long-distance cable transmitting power to the Aleko substation; one three-phase transformer of 7,500 kilovolt amperes, 10/20 kilovolts, feeding the collecting betls of 20 kilovolts, out of which come four electric cables for the pumping stations and the region, and two stepdown transformers, of 320 kilovolt amperes and 10/ 0.4/ 0.23 kilovolts for its private needs.

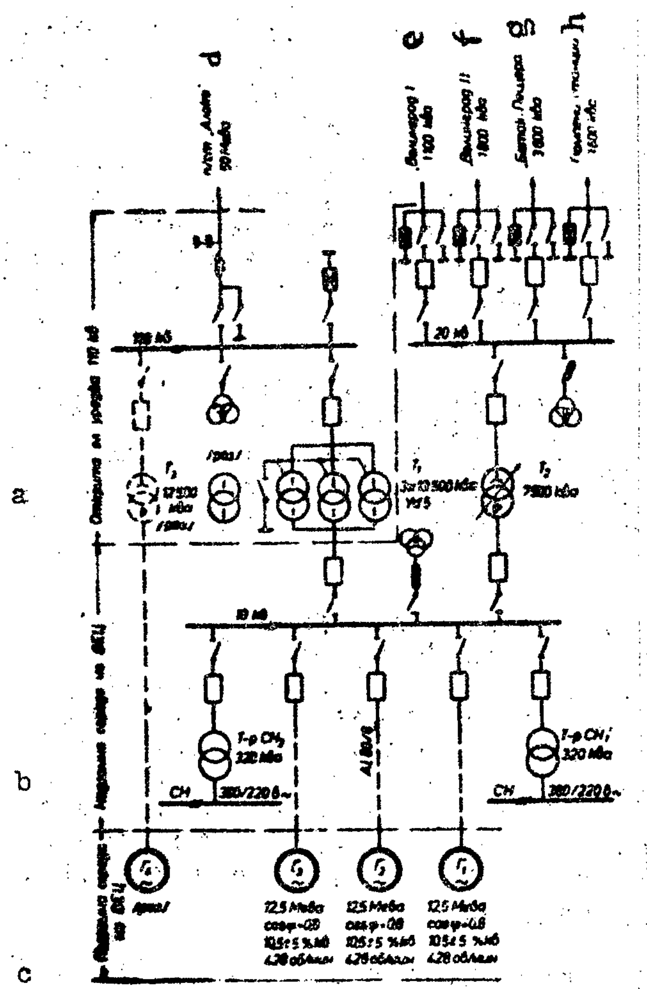


Figure 2

Electric Scheme of "Batak" VETs

a - Opened series /?/, 110 KV; b - Above-ground VETs installation; c - Underground VETs installation; d - p/cm "Aleko", 5 mgva; e - Velingrad I,1,100 kva; f - Velingrad II, 1,800 kva; g - Batak-Peshtera,3,600 kva; h - pumping stations, 3,600 kvc /?/

The fourth generator, which will be placed later, will work in conjunction with a step-up three-phase transformer of 12.5 megavolt amperes, 10/100 kilovolts, directly connected to the 110-kilovolt belts. The water rejected from the power station is taken to the "Batak" reservoir via an underground canal (a non-pressurized tunnel 2,930 meters long, with a 1:1,000 drop and 3.30/3.30 diameter). Water is captured in the reservoir through a special fan-shapped device, which protects the lower canal from retro-erosion at times when the reservoir is empty.

Second Step

The second step of the system encloses the Batak reservoir with its lower belt containing the Bistritsa, Ravnogor, and Nova makhala collecting canals and the Peshtera power station.

Batak Reservoir and Its Canals

The reservoir is built on the Mu'tnitsa River at the end of the former Batshki pond, which is now used as its reservoir.

The wall of the dam is 35 meters high, homogeneous, covered with earth, and compressed clay with a volume weight of 2.10 tons per cubic meter, with slopes of 1:3 on both sides. At its foot, there is a drainage system with a reverse filter. The front wall is shielded from wave action by stone blocks and the back wall by wooden trunks, to prevent erosion and rain water damage. In the center of the basin there is a wedge preventing filtration 11 meters deep, filled with clay, and in front of the wall there is a clay cover 80 meters long which covers the river basin and part of the shores. There are no injection works in the basin.

The major outflow is on the right hand side of the river bank. The front cut-off is in a vertical shaft, while the rear one--a segmented cut-off--is located in a special building at the end of the tunnel.

The overflow located on the left shore has sloping trenches and a flow of 10 cubic meters per second.

The Bistritsa collecting canal, 33,452 meters long, takes the waters of the tributaries of the Bistritsa and Elivere Rivers, mainly in tunnels, south of Velingrad and gravitationally brings them into the Batak reservoir. This canal holds the largest amount of water--about one-third of the whole system.

The Ravnogor Collecting Canal: This canal carries the water from the tributaries of the Stara River south of Peshtera and Bratsigovo. It is built in channels and tunnels with a total length of 20,765 meters. It incorporates the lateral Fotinsk canal, by means of a pipe carrying 0.33 meters per second. The Ravnogor canal crosses the valley of the Stara River through iron pipes (1,300 meters long, 1.2 to 1.4 meters in diameter, for 250 meters pressure).

The Novamakhala Collecting Canal: This canal takes the waters of the tributaries of the Stara River south of Batak and leads them through a lower ditch of the Batak VETs into the Batak reservoir. It is a covered canal 12,221 meters long.

The "Peshtera" VETs

This is a typical sub-reservoir station with an indirect drop. It is built totally underground in order to use to an optimum the topographic advantages of the drop in one step.

The water tower is 31.5 meters high and is constructed so that it takes water from the Batak reservoir only from its highest, warmed layer, which is least appropriate for irrigation. The cut-off apparatuses are located behind the tower; adjacent to it is a sloping cut-off of the "Vegital" type, and 80 meters from it a valve (2.8 meters in diameter) is located in a vertical shaft 4.7 meters in diameter and 25 meters deep.

The long irrigation tunnel of 2,988 meters (2.8 meters in diameter) has a 20-centimeter concrete facing and a steel ring of 3 centimeters and 6 centimeters in the weaker parts. Injection works were built in both stages, as in the tunnel of the Batak VETs, and, for the sake of greater smoothness on the reinforced inner facing, it was covered with inertol.

At the end of the irrigation canal is a water tower 52 meters high and 3.3 meters in diameter, having a lower chamber--a tunnel 2.6 meters in diameter, 3.3 meters high, and 24 meters long--and an upper chamber 12 meters in diameter and 9 meters high. Its facing is made of concrete.

Behind the water tower, there is an underground apparatus chamber at the beginning of the irrigation canal. As in the Batak VETs, there are two valves with a diameter of 2.4 meters: a regular and an emergency one.

The pressure tubing canal is made of concrete 1,374 meters long, divided into three construction segments by two windows. Its slope is 37 to 52 percent. Geological conditions necessitated a lope of 157 percent (70 degrees) in the lower 180 meters, which considerably complicated the construction. Its diameter is 2.70 to 2.30 meters, with a steel pipe 10 to 36 millimeters thick. The space between the pipe and the wall (50 centimeters on the average) is filled with concrete, laid in the usual way for the two upper segments and by the segmented method for the lower one.

In the horizontal distribution sector, the pipe is divided into five tubes 1.2 meters in diameter, which subsequently bifurcate, and thus ten pipes of 65-centimeter apertures bring the water to the turbines.

In the underground machine room (dimensions 83 x 28 x 12 meters) there are five aggregates made of a horizontal three-phase synchronized generator with 3,200 kilovolt amperes, 10.5 $\pm$ 5 percent kilovolts, 600 revolutions per minute, 50 periods, $\cos \varphi = 0.80$, made by Simens, coupled on both sides with two similar horizontal water turbines of the Pelton types, made by Foit, with two segments each having 35,800 horsepower, a maximum drop of 579 meters, 5.25 cubic meters per second of water flow, η = 85.5 to 89,5; 600 normal revolutions, and margins of 1,080 volts per minute.

The entrance tunnel leading to the machine room is 485 meters long, with diameters of 4.50/450 meters, and a 10-percent drop. The ventilation tunnel with dimensions of 3/7.5 meters, 420 meters long, and a 20-percent drop has three levels; power is transmitted through the first via three tri-aluminum belts to the open-air step-up substation; the remaining two are used for ventilation.

Table 2

Basic Data on the Reservoirs of the Batak Water-Power System

Reservoir	Volume of Dam in 10^6 m3	Flooded Area in km2	Height of Wall in m	Length of Crown in m	Volume of Wall in 1,000 m3	Water Flow per Year in 10^6 m3	Type of Wall
V. Kolarov	65.00	4.20	46.5	191	240	131.00	Stone blocks
Beglika	1.44	0.33	18.3	74	7.0	8.9	Massive concrete
Toshkov Chark	1.80	0.25	18.5	82	19.2	22.2	Stone blocks
Batak	315.00	22.0	35.0	273	400.0	304.8	Piled earth
Batak counter wall	-	-	9.9	393	50.0	-	Piled earth

The station is totally automated, controlled and regulated from the machine and control rooms. In the control room on the top floor of the machine hall are located all the electrical distributing systems, accumulators, and climatic installations, as well as the transformers for the station's own use (two each having 560 kilovolts and 10/0.4 to 0.23 kilowatts).

On the ground floor are located only the step-up transformers, two groups with three sing-phase transformers, each of 20,000 kilovolt amperes, 10.5/242 ± 2 x 2.5 percent kilovolts, of the Odg 20,000/220 type, made in the Soviet Union, hooked up on the lower side in a triangle and on the higher side in a star formation, with a directly grounded zero.

The electric scheme of the station shown in Figure 3 is as follows: There are two independent sections developed in the generators with a tension of 10.5 kilovolts, and two generators are plugged into each section. A special section for a fifth generator will be built later. At tensions of 220 kilovolts, a single system is created to which both transformer groups as well as the reserve field for the third transformer are joined, and in addition that which will be built for the fifth generator, plus the lead of the 220-kilovolt electric cables going up to the Aleko substation.

The transformers' own requirements are supplied by tension from the generator. A third transformer is anticipated in the reserves, which will be connected to the regional network of 20 kilovolts.

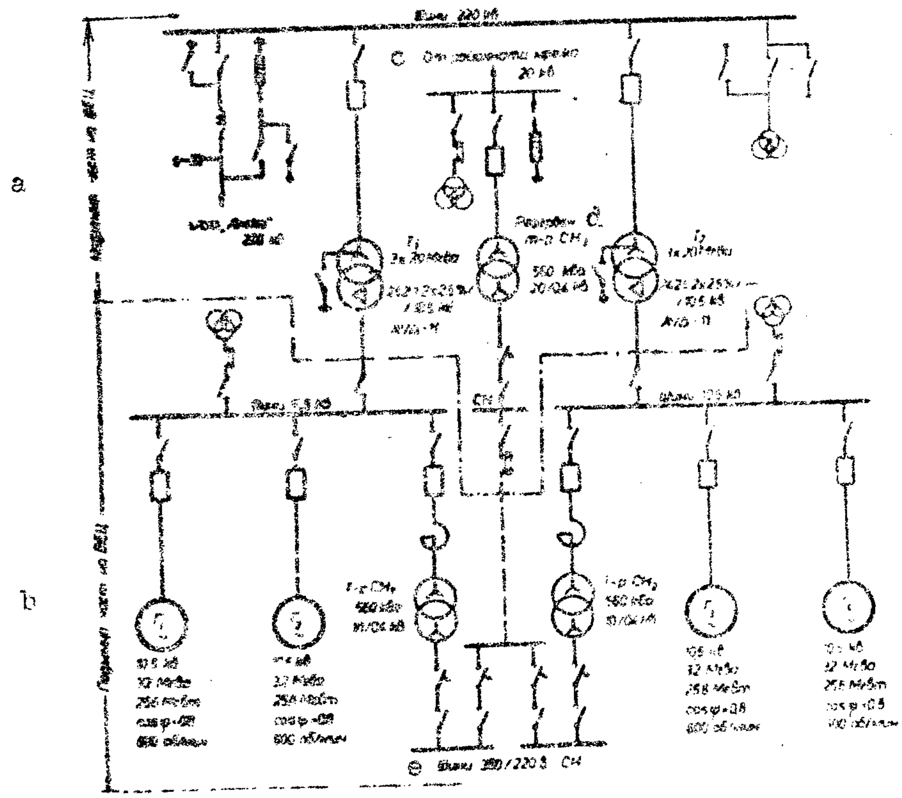


Figure 3

Electric Scheme of the Peshtera VETs--First Stage

a - Aboveground part of the VETs; b - Underground part of VETs; c - From regionalized network; d - reserve /?/ e - shini: ring or circle.

[On these diagrams the following units of measurement may be identified: кВа — kva; МВа mgva; МВт mgvt; об/мин - revolutions per minute]

The water used in the station is taken to the Aleko VETs via a lower underwater canal. As it is a nonpressurized tunnel, it begins in the distributing plant where the major derivation tunnel of the Aleko VETs starts. Here also is brought the additional water from the Stara River.

Third Step--Aleko VETs

The Aleko VETs is localized as a separate step from the Peshtera VETs, since the topographic situation made it impossible to use, in one station, the drop between the Batak reservoir and the Pazardzhik Valley. The terrain conditions for building a daily leveling station, pressure pipe channel, and the water twoer of the Aleko VETs made it necessary that the Peshtera VETs be built underground in order to avoid interrupting the drop once more by an intermediate station.

The major derivative tunnel of the power station is 9,912 meters long, nonpressurized, 3.6/3.6 meters in diameter, with a 1:1,000 drop, and a flow of 28 cubic meters per second.

The daily leveling station is built at the end of the derivation channel at the only appropriate place. Its volume is 165,000 cubic meters; it was built by excavating, and the surrounding steel-concrete wall of the Ambursen type is 6.5 meters high. The terrain necessitated the building of a low-pressure tubing 685 meters long (3.2 meters in diameter) from the daily leveling station to the pressure pipe.

The underground water tower, 33 meters high, has two chambers. The upper one is 13 meters in diameter and 700 cubic meters in volume; it is built of concrete and rises above the ground. The lower chamber is a closed tunnel 30 meters long, 3.5 meters in diameter and 2.6 meters in cross section.

The pressure tubing canal is made in four parts: from the water tower to the apparatus chamber is a tunnel 41 meters long and 3 meters in diameter; an open section 603 meters long (double steel pipe 2.2 meters in cross-section); a closed part (shielded) 470.5 meters long and 2.9 meters in diameter; and a distributing section (underground, horizontal) 97 meters long and 2.6 meters in cross section. Through the power station the tubing branches into three pipes 1.4 meters in diameter--one for each turbine.

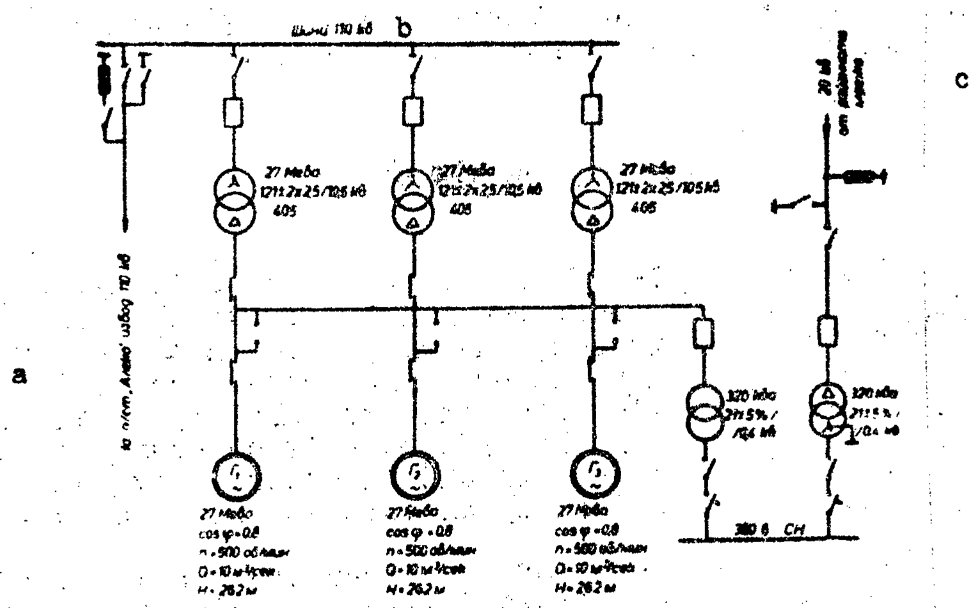


Figure 4

Electric Scheme of the "Aleko" VETs

a - p/cm "Aleko" outlet; b - circle or ring; c - from regionalized **network.**

In the underground steel-concrete building of the power station (dimensions 58 x 57.6 meters, 15,000 cubic meters) there are three turbines, of the "Frances type--vertical, 23,300 kilowatt capacity, maximum drop of 260 meters, water flow 10 cubic meters per second, $\eta = 91.5$ percent, 500 normal cycles, 845 maximum cycles per second, made in Czechoslovakia. Each turbine is coupled with a vertical, three-phase synchronized generator with a 27,000-kilovolt ampere capacity, 10.5 ± 5 percent kilovolts, $\cos \varphi = 0.80$; 50 kilocycles.

Adjacent to the machine room is the control room, in which there is a 10- and 20-kilovolt system, transformers for the station's own use, batteries, and offices. All the mechanisms of the turbines are constructed for local and remote control.

The station has the following electric scheme (Figure 4): each generator is joined to a step-up 27-kilovolt ampere transformer, $10.5/121 \pm 4 \times 2.5$ percent kilovolts, joined by a common 110-kilovolt belt in an open system. The needs of the station are supplied by one 320-kilovolt ampere transformer, $10.5/0.4$ to 0.23 ± 5 percent kilovolts, that can be switched to each generator. When the station is not functioning, its own needs are supplied by a transformer fed from the regional 20-kilovolt grid. The power is transmitted to the Aleko substation by a 110-kilovolt cable.

Via the lower channel, the used water is carried either to the irrigation canal or to the lower daily leveling canal. The water overflowing from the upper daily leveling canal is taken to the lower one through an open channel.

Table 3

Basic Data for the Electric Power Stations

Station	Drop in Meters	Water Flow m3/sec	Number of Groups	Power	Water Used in 10^6 m3 per Year	Power Produced, mw/hour/year	Total Load hours per year
Batak	420.5	13.6	4	40	129.30	100,900[1]	2,800
Peshtera	591.5	26.6	5	120	282.80	350,540	2,970
Aleko	283.0	30.0	3	60	299.20	163.200	2,780
Total	1,295.0	-	12	220		614,640	2,850

[Footnotes on next page]

[Footnotes to Table 3]

[1]Electrical production of the "Batak" VETs is decreased by the amount of power required for the pumping stations--11.1 million kilowatt hours per year.

New Characteristic Indicators

The following technico-economic factors are characteristic of this hydroelectric system: 166,000 kilowatts of installed power, which would mean 220,000 additional kilowatts for each station after the additional turbines are built; 4,320 leva invested per kilowatt; capital investment of 1.54 leva per kilowatt of electric power produced, and 4/3 stotinky per kilowatt hour as the current price of electric power.

A total of 72,505 meters of tunnels were built, as well as 92,952 meters of open canals, 4,597 meters of siphons, 137 kilometers of new internal roads, 200 kilometers of telephone lines, 131 kilometers of temporary electric cables for 20 kilovolts, 70 kilometers of temporary water channels, 320 living quarters, and 450 production buildings.

The more important construction work consists of the following: 2,700,000 cubic meters of underground and surface excavations, 647 cubic meters of concrete work, 500,000 cubic meters of piled earth, 210,000 square meters of masonry work, 610,000 square meters of cement facings--of which 130,000 square meters were of concrete. Technicans assembled 13,073.5 tons of machinery.

The following basic building materials were used: 220,000 tons of cement, 76,000 cubic meters of wooden material, 1,600 tons of explosives, 9.5 million bricks, 4,200 tons of steel-concrete, 530,000 cubic meters of [roof] tiling, 520,000 cubic meters of sand, and 1,870 tons of quick lime.

In the process of construction 7,049 construction machines were used: 129 compressors, 65 concrete cement mixers, five cranes, 103 Diesel and electric tunnel engines, 60 tunnel loading machines, 934 wagons, 13 tractors and bulldozers, 37 stone breakers, 31 injection pumps, 57 digging machines, 204 trucks, etc. The total power of machines taking part in construction work was 37,000 horsepower, with an additional

54,000 horsepower of the trucks; the worker-machine ratio corresponded to 6.1 and 8.9 horsepower.

During the period of the most active work (1956), an average of 10,500 workers took part in the construction work--5,700 construction workers; 1,150 engineers, technicans, and employees; 1,500 mechanics; and more than 2,000 "soldier-workers." More than 8 million man-days were invested in the project.

* * *

The successful opening of this largest Bulgarian water-power system pleased not only those who took part in this program but also the whole of the Bulgarian people. It constitutes a major step forward in the building of socialism in Bulgaria--an enterprise which injects vital juices into our industry as well as our agriculture. With the projected "Shiroka polyana" power station and the "Nesta" canal, whose construction has begun, the effect of the Batak waterway will increased by 915 million kilowatt hours and make possible the irrigation of 500,000 decares. This is a valuable contribution to the anticipated economic leap forward during the Third Five-Year Plan.

Footnote

The main data for the derivative and collecting canals as well as for the water-collecting region and the captured water volume for the reservoirs is given in Table 1.

1827

EAST GERMANY

The New TF Long-Distance Cable System in East Germany

[This is a translation of an article by Hellmut Graf in Deutsche Post, October 1958, Leipzig, pages unknown; CSO: 3486-N]

The German long-distance cable network established by the former deutche Reichspost (German Postal System) consisted of low frequency (LF) long-distance cables of many different types and of multiple cable lines from Berlin to Munich, Frankfurt (Main), Hamburg, and Hanover.

The development of this long-distance cable network which has been made necessary by the growth of communications over great distances has been amply described in an earlier article. Table 1 shows the improvement made over the years in the electrical characteristics of the long-distance cables, which is expressed particularly in the rise of the frequency limits f_o and in the increase of the transmission speed in the L and S cables.

The design of the LF long-distance cables in operation within the territory of the GDR shows a great variety. During the first years of the establishment of the network, 98 pairs of normal long-distance cables of type A (40 DA 1.4 millimeters; 50 DA 0.9 millimeters) were uniformly used, and where there was a heavy volume of traffic 166 pairs of normal long-distance cables of type B (40 DA 1.4 millimeters; 126 DA 0.9 millimeters) were used.

With the growth of the long-distance cable network, its hook-up with foreign networks, and the introduction of the Tietgen protection in the place of the original protection of the quadruple core through a special lead covering and covered pairs of strands as conductors for radio broadcasts, a multiplicity of cable designs was developed, since a new cable design was worked out for each new line. This multiplicity was further increased through the replacement of copper conductors with aluminum conductors with the same electrical transmission value (1.15/1.8 Al instead of 0.9/1.4 Cu). Each marine telephone cable from Germany to Denmark and Sweden was likewise given a different design. Figure 1 shows a cross-section of the strongest LF long-distance cable with 218 DA (46 DA 1.4 millimeters; 172 DA 0.9 millimeters), which provides approximately 300 call channels.

Table 1

Electrical Qualities of German Long-Distance Cable Lines Laid until 1945

Spooling	Conductor Diameter (mm)	Spooling Trung/ Phantom (mH)	Spool Interval (km)	Reduction (mN/km)	Frequency Limit (Herz)
1	2	3	4	5	6
Rhineland cable	2.0	240/80	1.7/3.4	5/6	2660/2440
	3.0	152/80	1.7/3.4	3.1/3.5	3140/2310
Heavy	0.9	200/70	2.0	17.7/18.7	2710/3660
	1.4	190/70	2.0	8.9/9.1	2690/3465
Light	0.9	50/20	2.0	31/31	5430/6830
Medium heavy	0.9	140/56	1.7	19.0/18.6	3500/4400
(M lines)	1.4	140/56	1.7	8.9/8.8	3410/4270
Light	0.9	30/12	1.7	36/34.8	7470/9300
(L lines)	1.4	30/12	1.7	17/17	7260/8980
Very light (S lines)	1.4	3.2	1.7	40	19130
?abespult ? lines*	1.4	-	-	46	-

Spooling	Amplifier Interval (km)	Transmission Speed (km/sec)	Range for Running Time of 100 meters per second (km)
1	7	8	9
Rhineland cable	-	-	-
	-	-	-
Heavy	140 Vdr**	17,000	1,700
	140 Zdr	17,000	1,700
Light	70 Vdr	34,000	3,400
Medium Heavy	140 Vdr	18,000	1,800
(M lines)	140 Zdr	18,000	1,800
Light	70 Vdr	35,000	3,500
(L lines)	140 Vdr	35,000	3,500
Very light (S lines)	70 Vdr	105,000	10,500
?abespult ? lines*	35	220,000	22,000

*[illegible]
**[Vdr and Zdr not identified]

In accordance with the importance of Berlin as the capital of Germany, the first long distance cables were laid out in star formation from Berlin to Cologne via Hanover, to Frankfurt (Main) via Leipzig, to Stettin, Stralsund, Hamburg-Flensburg, Breslau, Dresden and Leipzig-Munich. In addition to this, there were cross connections between important cities--for instance, Leipzig-Dresden-Plauen, Leipzig-Halle-Magdeburg, and Stralsund-Rostock-Hamburg--as well as connections to the cable networks developing in neighboring countries, such as the Dresden-Prague, Stralsund-Malmo and Rostock-Copenhagen lines. The raising of the frequency limits f_o to approximately 7.5 kilocycles achieved through light spooling made it possible to utilize the carrier frequency of the L lines in the form of two-band calls. This means that in a ground cable a carrier frequency (TF) channel is provided for an additional call (carrier frequency, 6 kilocycles) besides the low-frequency call. The two-band call system which was used for the first time in 1930 in the cable to Sweden became increasingly important in the following years and increased the profitability of the long-distance cable network. It is still important today in the long-distance cable network of the GDR.

The broad-band cables contained for the first time several unspooled lines, in which the TF System MG 15 with 15 call channels and a zero-frequency interval of 3 kilocycles was used at first and then the twelve-channel system U 41 with a zero-frequency interval of 4 kilocycles in accordance with the CCIF [not identified] recommendations.

After 1945 some of the 1.4 millimeter veins in some of the long-distance cables of the GDR were unspooled and reinforced with TF systems Z 8 for eight call channels with a zero-frequency interval of 3 kilocycles in order to obtain additional conductor channels.

The spooling of the long-distance cables, which alone made them suitable originally for long-distance traffic, was thus abandoned again in the course of further development, and unspooled cables were introduced or spooled cables were unspooled in order to make multiple use of carrier frequencies.

The use of carrier-frequency systems in unspooled long-distance cables is subject to certain limits, since they can be compensated for only up to 60 kilocycles, or, in the case of more modern types, up to 108 kilocycles within economically justifiable cost limits. In lines which consist of only one long-distance cable, only Z 8 systems with a transmission frequency interval of 6 to 60 kilocycles can generally be used.

Only on the few lines consisting of two long-distance cables can twelve-channel systems in a four-wire parallel switch (transmission frequency band: 12 to 60 kilocycles) be operated. Furthermore, on account of the secondary call conditions which must be maintained, only a limited number of veins in a cable can be unspooled and utilized in carrier-frequency fashion. It must also be taken into account that the switch-off of the quadruple cords to be unspooled causes considerable difficulty because of the already existing shortage of circuits, and that the unspooling of a quadruple cord results in the temporary loss of 3 NF [presumably, low-frequency] circuits.

The Requirements to Be Met by the New Long-Distance Cable Network of the GDR

In its present condition, the long-distance cable network of the GDR no longer meets the requirements with respect to quality of transmission and the steadily rising needs of socialist society.

According to the recommendations of the CCITT (Comite consultatif international telegraphique et telephonique; International Consultative Commission for Telegraph and Telephone), telephone channels in all international lines are supposed to effectively transmit cycles within the frequency band of 300 to 3,400 cycles. The existing lines, however, which are predominantly spooled medium to heavy with 140/46 milliherz (mH), have only a maximum frequency transmission of approximately 2,400 cycles in their trunk and about 3,000 cycles in their phantom. In the L-lines which are used for two-band calls the NF and the TF call channel also transmit only a frequency band of 300 to 2,700 cycles. The transmission range of the call channels which are provided by means of the large numbers of Z-8 systems used in the long-distance cable network of the GDR also lies only between 300 and 2,600 cycles. Thus the long-distance cable lines of the GDR do not correspond to the recommendations of the CCITT for international communications. This also applies to the running time and the differences in running time. According to the recommendations of the CCITT the running time in an international line should be less than 100 meters per second (ms) and the differences between the running time of the cycles with a frequency of 800 cycles and the running time of the actually transmitted cycles of the lowest and highest frequency should not exceed 10 or 5

meters per second. In the case of the medium-heavy spooled and the light spooled lines, this results, according to column 9 of Table 1, in ranges which are inadequate for international long-distance traffic.

Also with respect to the number of lines to be switched, the long-distance cable network of the GDR has reached the limit of its capacity despite the utilization of carrier frequency, and the technical and economic control figures for long-distance telephone traffic cannot be improved any further because of the shortage of circuits.

Added to this is the fact that the long-distance cable network in existence in 1945 within the territory of the present GDR was designed according to criteria which no longer correspond to the requirements of the administration, the economy, and the population of the GDR. The division of the territory of the GDR into bezirks, carried out in 1952, necessitates the existence of an adequate number of lines between the capital of Berlin and the bezirk cities as well as between the bezirk cities themselves, in order to assure the administrative operations of the state.

New lines are also required by the new industrial and economic centers which have come into existence since 1945 or will come into existence. In this connection one may mention the shipyards on the Baltic coast, the ports of Wismar and Rostock, the brown coas mining and processing industry in Cottbus Bezirk, the iron-smelting combines, and the copper mines. The steadily increasing cooperation in our socialist industry will naturally result in a steady increase in the need for communication between widely separated bezirks of the GDR--for instance, between the shipbuilding industry in Wismar, Rostock, and Stralsund, and the supplier plants in Saxony and Thuringia. The increasing trade with friendly socialist countries will likewise result in a need for more lines to foreign countries, which the existing long-distance cable network can likewise no longer provide.

This presently already existing need for additional lines will increase considerably within the foreseeable future with the introduction of direct dialing between exchanges, which will eliminate waiting periods, and particularly with the introduction of direct long-distance dialing in the GDR. Also in the international terminal and transit traffic the gradual transition, first to inter-exchange dialing and later to direct long-distance dialing between participants, will have

to be reckoned with, as well as the increased demands on the long-distance cable network of the GDR, situated as it is in the heart of Europe.

This enormous need for lines, which furthermore are to be switched only on a quadruple wire basis, can, with respect to the financial and material as well as the technical requirements (transmitted frequency band, muffler distortion, running time, and running time distortion) no longer be assured with the present methods of low-frequency technology but only with TF systems with a higher number of channels, which in turn require a special TF long-distance cable network.

This new long-distance cable network must, in accordance with what has been said previously, connect the bezirk cities of the GDR with Berlin as well as the neighboring bezirk cities with each other, and it must also assure the connection to the long-distance cable networks of the friendly countries, to the German Federal Republic, and to the Scandinavian countries. The TF long-distance cable network must also provide an opportunity to exchange, on coaxial lines, television programs with neighboring countries and transmit the television modulation from and to the television studios of the GDR as well as in transit through the GDR into other countries.

The Structure of the New Long-Distance Cable System in the GDR

TF lines can be provided either by means of TF systems with a small or medium number of channels (V 12...V 120) in symmetrical cable lines, or by means of multi-channel TF systems (V 960) on asymmetric coaxial lines.

If TF systems with symmetrical lines are used, it is possible to relate the number of systems used to the gradually increasing volume of long-distance traffic, insofar as initially not all lines will use TF systems, and only systems with a smaller number of channels will be used which, with increasing requirements, can then be exchanged for systems with a higher number of channels. The graduating, branching, and adding of channels can be carried out in symmetrical TF cables without any special branch switchings and without any demodulation, as can be seen in Figure 2, by using V 120 systems between points A and C, and by using V 24 or V60 systems between points A and B, B and C, A and D, and D and C. TF systems with a small or

medium number of channels also offer the advantage of higher operating safety, since the breakdown of a system does not cause the breakdown of the entire traffic connection. A disadvantage lies in the fact that in the case of symmetrical TF cables the intermediate amplifier stations will require a special amplifier for each TF system and for each direction.

Also in the case of multi-channel TF systems (f.i. V 960), which are composed of the twelve-channel basic groups (60 to 100 kilocycles) recommended by the CCITT and of the 60-channel super groups (312 to 552 kilocycles), basic and super groups of 12 or 60 channels can be switched through by means of suitable filters without any transformation into low frequency and can be branched off or joined by means of blocking filters in the intermediate stations without any loss of the frequency band.

The branched-off groups or super groups can end in the intermediate station, or they can be carried further in other TF systems. On account of the narrow frequency gaps between the basic groups or the super groups--which amount to only 8 kilocycles between two super groups, for instance--very high demands must be made with respect to the separability of the filters. Since in a distrubance in a tube a strong line bundle would be put out of operation, at least one spare tube would have to be provided in a multi-tube channel in order to assure the necessary operating safety. The structural groups, which would be the same in the TF terminals and in the intermediate amplifiers for the entire system--for instance, the line amplifiers and the suppliers of carrier current--would each have to have a second alternate which could be switched automatically from reserve into operation and vice versa in order to prevent a breakdown of the entire system.

It furthermore appears to be practical and economical in densely populated areas in which medium size bundles of different strengths have to be provided over distances less than 500 kilometers and in which a flexible line network is required that TF systems with a medium number of channels be used on symmetrical lines, and that, on the other hand, multichannel systems on coaxial lines be used for traffic connections over long distances which require a large number of lines. In any case, the most practical use of cables and carrier frequencies will have to be determined on the basis of thorough traffic analyses and economic studies.

On account of the dense population and the need for relatively short cable bundles of varying strengths, the German Postal Administration has begun to build a new TF long-distance cable network with symmetrical lines, which upon completion will connect the bezirk cities with Berlin and with each other. Depending on the estimated requirements for cables over the next 25 years, 8 or 14 pairs of TF long-distance cables with a coaxial line and 16 symmetrical pairs of wires are being laid out wherever it appears necessary to provide for the transmission of television broadcasts. A special cable must be provided for each transmission direction for sound transmission.

To meet the need for telephone and teletype lines for international and transit traffic, as well as the need for television transmission lines for the exchange of programs with and between neighboring countries, it has furthermore been planned to lay out multi-tube cables within the territory of the GDR.

The Design of TF Long-Distance Cables

Symmetrical TF Long-Distance Cables

Symmetrical TF long-distance cables are manufactured by the VEB Oberspree Cable Works as star pattern cables with paper or styroflex insulation.

The paper-insulated TF long-distance cables have copper wires of 1.2 millimeters thickness with hollow insulation of paper and with a wave reduction of 345 milliherz (mH) per kilometer at 252 kilocycles. Assuming an amplifier field reduction of 6.5 N at 252 kilocycles, which corresponds to an amplifier interval of approximately 18 kilometers, they can be utilized with TF systems V 60 (transmission frequency band 12 to 252 kilocycles). A maximum of 8 x 60 = 480 speaking channels can be provided in an 8-pair TF long-distance cable. The structure of such a cable is shown in Figure 4.

The styroflex-insulated TF long-distance cables have copper wires of 1.3 millimeters thickness with an insulation of styroflex threads and ribbons and with a wave reduction of 360 milliherz per kilometer at 552 kilocycles. These styroflex-insulated cables, which are only by 0.1 millimeters

thicker than the paper-insulated TF long-distance cable, can be utilized with TF systems of type V120 (transmission frequency band 12 to 552 kilocycles) with an amplifier field reduction of 6.5 N at 552 kilocycles and with the same amplifier interval of approximately 18 kilometers. A maximum of 8 x 120 = 960 speaking channels can be utilized in an 8-pair TF long-distance cable with styroflex insulation. This means that, with the same amplifier interval and only 17 percent more copper, twice as many speaking channels can be provided than in a paper-insulated TF long-distance cable with the same number of wires. Figure 4 shows the structure of an eight-pair styroflex-insulated cable.

In traffic lanes where a greater number of lines is required, 14-pair TF long-distance cables with copper wires of 1.3 millimeters thickness and with styroflex insulation are used. These can utilize a maximum of 14 TF systems of type V 120 and can therefore provide 14 x 120 = 1680 speaking channels.

TF Long-Distance Cables with Coaxial Lines:

For traffic lanes which require, besides the speaking channels, also a transmission line for television 17-pair TF long-distance cables, [the cables] are manufactured by the Oberspree Cable Works which contain in their core a coaxial line--also called a coaxial tube--surrounded with eight quadruple cables with 1.3 millimeter styroflex-insulated wires. The coaxial tube has an inner conductor of copper with a thickness of 3.4 millimeters and an insulation of polystyrol disks which are slipped over the inner conductor, and an outside conductor of copper tubing with an interior diameter of 12.7 millimeters. The tube therefore does not have the dimensions of 2.6/9.4 millimeters which have been recommended by the CCITT. With an amplifier interval of 9 kilometers it can be utilized for the transmission of television signals within the frequency range of up to 8.5 megacycles. In a two-track cable two television transmission channels are therefore available. In the 16 symmetrical lines which surround the coaxial tube a maximum of 16 x 120 = 1,920 speaking channels are provided by means of V 120 TF systems with an amplifier interval of 18 kilometers. It is intended to build the tube with the dimensions recommended by the CCITT (2.6/9.4 millimeters). This will make it possible to transmit television signals within the frequency range of up to 6.5 megacycles, with amplifier intervals of 9 kilometers, and within the frequency range of up to 8.5 megacycles with amplifier intervals of 6 kilometers.

In both tubes of a line consisting of two 17-pair TF long-distance cables, a TF multi-channel system V 960 with an amplifier interval of 9 kilometers can also be used instead of the two television transmission systems, which, according to the recommendations of the CCITT, requires a transmission frequency band of 60 to 4,028 kilocycles. Figure 5 shows the structure of a 17-pair cable with coaxial tube and eight TF quadruple cables (16 symmetrical lines).

According to the measuring data available from the first completed cable lines, it will be possible to utilize at least some of the styroflex-insulated symmetrical lines of a TF long-distance cable up to approximately one megacycle--ie.e, it will be possible to use V 240 TF systems and thus to increase the circuit capacity of the cables.

Multi-tube cables have been developed in the GDR, the Soviet Union, the German Federal Republic, and in other countries which have cables containing four, six, or eight coaxial tubes, as well as symmetrical pairs of wires in the core or in the spaces between the tubes. Each tube is magnetically insulated through a steel tape wrapping to prevent mutal influences. Thus TF systems can be operated in a four-wire parallel method in any two tubes in a multi-tube cable.

Figure 6 shows the cross section of a four-tube cable. It contains four CCI coaxial tubes of 2.6/9.4 millimeters as well as in its core one, and in the hollows [there are] four quadruple lines with 0.9-millimeter copper wire and various twists for service, signal, and remote control lines. The insulation between the outer and inner conductor of the coaxial tubes consists of polyethylene disks which are slipped over the inner conductor. The outer conductor of each tube is insulated with a wrapping of two steel tapes and with several layers of paper. The quadruple line at the core has shallac-coated veins (Tietgen insulation).

Table 2 shows the amount of copper and lead required per circuit kilometer for the various kinds of TF long-distance cables. It shows that styroflex-insulated cables require the least amount of copper and that the amount of lead required becomes less with increasing cable diameters; 17-pair combined TF long-distance cables require slightly more copper than TF long-distance cables, which contain only TF quadruples lines, since the coaxial tube of 3.4/12.7 millimeters is not fully utilized with a V 960 system. The copper requirement data, given for low-frequency two-wire and four-wire lines as well as for L-lines, show the great saving of copper

which results from the carrier frequency utilization of long-distance cables.

Table 2

Amounts of Copper and Lead Required per Circuit Kilometer

Kind of Cable or Line	Two-Track Copper kg/km	Cable Lead kg/km	No of Speaking Circuits	Per Speaking Circuit Copper kg/km	Per Speaking Circuit Lead kg/km
Insulation:					
8 x 2 x 1.2 paper	336	1,769	480	0.7	3.7
8 x 2 x 1.3 styroflex	380	2,600	960	0.4	2.7
14 x 2 x 1.3 styroflex	690	3,000	1,680	0.4	1.8
1 x 3/4 /12.7 and 16 x 2 x 1.3 styroflex	1,322	4,200	960 + 1,920	0.46	1.5
Two-wire line, 1.4 copper	-	-	1	18.4	-
Four-wire line, 0.9 copper	-	-	1	15.2	-
L-line, 0.9 copper	-	-	2	7.6	-

The new TF long-distance cable network of the GDR, consisting of symmetrical and coaxial lines, whose construction has been begun, will make it possible to provide, by means of TF systems, the bundles of line required for self-dialing traffic and for international and transit traffic and to exchange television broadcasts with the neighboring countries. Thus the network will contribute in an essential manner to the completion of the building of socialism in the GDR and to the consolidation of relations with the friendly socialist countries.

Photo and Figure Captions

Figure 1. Cross-section of a 218-pair low-frequency long-distance cable.

Figure 2. Graduation and branching of TF systems.

Figure 3. Eight-pair TF long-distance cable with paper insulation; right--cross-section; below--cutaway view.

Figure 4. Eight-pair TF long-distance cable with styroflex insulation.

Figure 5. Seventeen-pair TF long-distance cable with coaxial tube and eight TF quadruple lines; above--cross-section; below--cutaway view.

Figure 6. Cross-section of a four-tube cable.

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HUNGARY

Medium-Voltage Circuit Breakers in the Electric Power Industry[1]

[This is a translation of an article by Aladar Zimmermann, Director, Electrid Network Service (Villamos Halazati Szolgalat), in Villamossag, Vol VII, No 7, July 1959, Budapest, pages 199-207; CSO: 3451-N]

In the years following the war our electric power distribution installations and high-voltage lines multiplied very rapidly. Production and distribution of electric power vastly increased through the connection of new industrial plants and a large number of other consumers into the electric network. These events raised serious problems in the systematic development of modern power-distributing equipment. Short-circuit power has also increased along with the power lines, thereby raising the need for more reliability and safety.

Unfortunately, there was no similar advancement in the apparatus field, although the two problems are inseparable from the technical viewpoint. The unfavorable effects caused by this deficiency have impeded the operation for a long time.

In the maintenance of electric power lines, the high-voltage circuit breaker is one of the most important installations. In bringing our power distribution up to date or renewing obsolete equipment, it is a prerequisite that the manual or remote-controlled circuit breakers operate reliably by swiftly breaking the path of short circuits, thus removing the undesirable short-circuit loads from the line. The circuit breakers used should withstand the dynamic and thermal effects of the short circuits without any damage. In our power stations many of the presently used circuit breakers cannot suitably serve this purpose.

Consequently, the development of circuit breakers is a very important problem. There is still a lot of obsolete equipment being used whose technical characteristics are only approximately known or entirely unknown. For instance, on some of the old circuit breakers the interruption capacity is

not known, although it is essential in the operation of modern power lines. The same unfortunate situation prevails on some of the newly installed circuit breakers as well.

The fact that our presently used circuit breakers do not stand up to the requirements does not imply that we are putting the blame entirely on the manufacturers of these electric apparatuses. These factories could not possibly have produced the above-mentioned equipment in a suitable quality when they lack adequate and universal testing standards.

The general requirements of the power enterprises concerning circuit breakers are recapitulated in the following discussion.

The disadvantage of not knownng the capacity of a considerable portion of our presently employed circuit breakers can only be eliminated by gradually replacing the obsolete installations with reliably tested and proven products. At the present time, our factories are still delivering circuit breakers which have not been tested under actual short-circuit conditions, thus making the value of their specifications very questionable. It is absolutely essential that these factories turn out mass-produced and subsequently tested circuit breakers proved at short-circuit test stations.

The 35-kilovolt voltage level was approved about ten years ago. The previously used 30-kilovolt level has been mentioned in the standards only as a tolerated but other wise obsolete value. Today the 35-kilovolt level has been adopted on all medium-voltage lines except on the 30-kilovolt line of Budapest. In spite of this fact, all the equipment installed on the 35-kilovolt lines has been designated by a nominal voltage of 30 kilovolts, proving that the manufacturers have apparently disregarded the standard specifications. Many of the major breakdowns were traced back to this fact, showing that we must take urgent measures to put an end to this poor manner of operating. We have to not here that paragraph III.1 of the manual entitled "Installation and Maintenance of High-Voltage Circuit Breakers" (Nagyfeszultsegu megszakitok, szerelesi, uzembehelyezesi es karbantartasi utasitasok), issued by the TRANSZVILL[2] [Transformer and Electric Appliance Factory] on 1 July 1957, state the following: "The operating voltage of the power line shall not exceed the nominal testing voltage by more than 15 percent, as posted on the label attached to the enclosure of the circuit breaker." This corresponds to 34.5 kilovolts in the case of a 30-kilovolt cir-

cuit breaker. However, thd national standard No MSz 9250-54 R permitted the use of 30-kilovolt equipment up to 38.5 kilovolt maximum voltage. This contradiction proves that the 30-kilovolt circuit breakers are regularly overloaded beyond the manufacturer's specifications.

In reducing the number of breakdowns, the recloser is one of the most effective devices. According to domestic and foreign statistics, about 70 to 75 percent of the breakdowns can be prevented by using reclosers. In establishing automatic reclosure, it is a prerequisite to have adequate circuit breakers. This primarily refers to the circuit breakers accomplishing line closure and their drives, because these are subject to the heaviest stresses.

The first fast-acting reclosers were introduced in 1955 on our medium-voltage lines. Since that time our recloser technique has shown marked progress. About 18 central and 20 line reclosers were working on our medium-voltage lines in addition to those installed in 1958. The number of operating cycles was 1,206 of which 954--78 percent--were successfully achieved. An average circuit breaker operated 32 times, mostly during the four summer months. On some stations, the two standard circuit breakers operated 200 times during the same period, practically once a day.

However, the extensive usege of the reclosers has been hindered by the fact that our medium-voltage circuit breakers do not satisfy the requirements set forth by modern reclosing techniques. We are referring to the fact that in the event of a line reclosure the circuit breaker has to interrupt the line twice in succession if a sustained short-circuit load is present. On the presently used OTKF (manufactured by the Ganz Enterprise) and OM (made by TRANSZVILL) oil-free breakers and the VK expansion-breakers, the quenching chamber, owing to its present construction, is not capable of interrupting the nominal cutoff power in the even of an unsuccessful circuit breaking. It is true, however, that this has not yet been guaranteed by the manufacturers. On the PTK (made by Ganz) pneumatic circuit breaker, the capacity of the air-tank was not sufficient to provide the pressure for the in-out-in cycle. Some factories, such as the Klement Gottwald Works and TRANSZVILL, have already developed new models of the above-mentioned PTK and OM circuit breakers capable of reclosing three-phase lines; these new products have been successfully tested in Behovice, Czechoslovakia. The new models were only prototypes; as far as we know, mass-production should

have been started in the second half of the year. However, according to the latest available information, the Klement Gottwald Works will acknowledge orders only for 1962 for the new PTK circuit breaker. It is important that all manufacturers start mass-producing all current developments as soon as possible and at the same time eliminate old and obsolete products at least on the domestic market.

To meet the increased demands in the application of three-phase reclosers, not only the circuit breakers but also their drives must be of high quality. According to past experience, the best drives for three-phase reclosers are the motor-cound spring action drive and the pneumatic drive. The drives of the PTK and other expansion breakers are the most adaptable because they were made or converted for that special application. However, the air-drive of the expansion-breaker is rather slow; therefore, it is not recommended for short idling cycles. The manually wound spring action drive (made by TRANSZVILL) suffers from frequent failures (some of the parts break) and it is not adaptable for remote control.

In recent years the need has arisen for reclosing circuit breakers, to be installed on open-air 20-kilovolt poles. The 20-kilovolt lines are arranged in a radial manner with many T-shaped branches. Any one of these radial line branches can be cut off only by the circuit breaker located at the power station. A short-circuit on any of the T-branches would leave the whole radial system--and consequently all associated consuming districts--without power. If, however, reclosers were installed in some more important T-branches whereby an adequate solution would be provided for minor line defects, the main circuit breaker at the power station would only operated if the main line had been short-circuited. The situation would further improve if these pole-mounted circuit breakers were also adaptable for reclosures of relatively long (3-minute) idling cycles. In this case, the maintenance men would not have to go to the scene to reclose the circuit-breakers involved. In 1955 the TRANSZVILL promised to start in 1956 the production of 20-kilovolt pole mounted circuit breakers capable of reclosure and having a large quenching chamber; this, however, has not been achieved yet.

On and off switching on the main lines occurs quite frequently under normal load conditions because of the above-outlined network configuration in the system of operation; in the same time, short circuits are very infrequent. It would be more economical to use sectioning switches at these

places to handle normal load variations, while short-circuit protection could be achieved by means of high-voltage protective devices. New types of sectioning switches and high-voltage protective devices have recently been developed by the Research Institute for the Electric Industry (Villamosipari Kutato Intezet). Surprisingly good results have been obtained by short-circuit tests at the test station of Behovice. As far as we know, mass-production has already been started at the TRANSZVILL under the supervision of the Research Institute. However, we do not know the present state of development of the sectioning switches; the Ministry of Metallurgy and Machine Industry (Koho- es Gepipari Miniszterium) also has still to decide to whom to assign the project. We have also been informed about a new pneumatic sectioning switch developed by TRANSZVILL; unfortunately, we have no further news about their production.

We have to give some attention to primary cutoff switches, because a large percentage of our medium-voltage stations have been equipped with this protective device. The presently used primary cutoff switches have two basic deficiencies--particularly those recently delivered. First, their operation is inaccurate. The reason is that--on the basis of a recent patent--one of the two normally snapping nips has been eliminated on the timing mechanism and a thinner toothed wheel has been introduced, where by the rachet drive can easily slip and the switch acts faster than the preadjusted time. The other deficiency is inadequate thermal stability. Generally, the thermo-current of the primary cutoff switches is 60 I_n. As can be seen, this figure is not sufficient in many cases. As far as we know, the Ganz Switching Apparatus Enterprise (Ganz Kapcsolo- es Keszulekgyar) has already developed a new primary cutoff switch based on the recommendations of the Power Station of Budapest (Budapesti Elektromos Muvek), which eliminates both of the above-mentioned deficiencies. However, mass production of the new switches has not yet been started. We take advantage of this opportunity to urge the competent enterprises to go ahead with this project as soon as possible.

Short-circuit tests have been carried out on domestic circuit breakers on three occasions at the test station of Behovice. Generally, the tested products have been found satisfactory. Although the last tests were made about nine months ago, there still has not been any decision on the mass production of these important items. Some types could be ordered immediately, but, owing to unfavorable delivery terms,

we cannot count on these products in the near future. In the past, power enterprises have complained that circuit breaker orders have only been acknowledged for two to three-year deliveries, thus considerably delaying their planning and line-development work. The competent authorities should investigate the cause of these delays.

We also have to deal with the problem of spare part supplies. It is a well-known fact that the various circuit breaker parts have different life spans. Some of them are subject to heavy operational stresses while others frequently have to be replaced because of inadequate material quality or production inaccuracy. If we had a sufficient spare part supply, defective circuit breakers could be repaired and put back into operation. Heretofore, the factories have refused to provide spare parts, although in our opinion this would not constitute an additional load on their production.

Another problem is changing the quenching liquid in the circuit breakers. At present we neither have even the approximate data necessary to determine the life span of quenching liquids (oils, expansions, etc.) nor can we determine the influence of the operational circumstances on the time needed to renew these liquids. We have encountered quite different opinions in the industry concerning this question, although it would be better to establish an optimal common view by taking relability and economy factors into consideration. According to the manufacturer's specification, the circuit breakers should be serviced and the oil changed after two to three nominal short-circuit occurrences; this would mean that--owing to the previously mentioned high average number of reclosures--the breakers must be disassembled almost every other day; this, of course, cannot be taken seriously. We suggest that the Research Institute for the Electrical Industry include this problem in their development work.

We also have to establish a common practice in maintaining the circuit breakers and other protective devices. In our opinion, the best way would be to form a committee of experts made up of both producers and customers to work out the universal maintenance principles for domestic circuit breakers.

In recent years, the quality of our circuit breaker production has considerably improved. One of the reasons was that the factories have turned to producing a small number of proven types. In eliminating the deficiencies, considerable experience was gained by making the same types for a prolonged

period of time. On the other hand, efforts to develop new products were heavily curbed. As we mentioned before, some new circuit breaker types have been developed and tested in laboratories and at short-circuit stations, but their mass production has been repeatedly delayed. The Electric Power Department of the Ministry of Metallurgy and Machine Industry should encourage development projects by paying incentive bonuses out of a fund to be established for this purpose; mass production of the already developed and tested products should also be stressed.

The fact that the factories usually do not disclose their program to the power companies has frequently caused confusion in building new installations, not to mention the considerable delay caused by extended delivery terms owing to production changes. The factories should inform the customers from time to time about production problems and new developments.

Naturally, we are aware of the fact that the factories alone cannot cope with the requirements of circuit-breaker production. The consumer enterprises should maintain a permanent and close contact with the manufacturers; their experiences should be statistically recorded by pointing out the exact causes and types of failures and defects. This statistical information should eventually be made available to the manufacturers. We therefore pledge here full cooperation on the part of the Electric Network Service.

In the future we want to stress the importance of proper maintenance of our medium-voltage circuit breakers. This service will be performed by circuit-breaker shops and mobile repair groups now being organized. Two maintenance shops will be set up in the major districts; one for the Power Enterprise of Northern Dunantul in Gyor (Eszakdunantuli Aramszolgaltato Vallalat) and one for the Power Enterprise of Northern Hungary in Eger (Eszakmagyarorszagi Aramszolgaltato Vallalat). The concrete and numerical data gathered by them will provide valuable material for the development of new products or improving the present ones.

Finally, we repeat here the need for a domestic short-circuit test station whereby our apparatus and circuit breaker production and development would be considerably promoted. This test station could widen the scope of type tests and type selections, which in turn would be very favorable for both the

factories and consumers and consequently for the nation's economy.

After a satisfactory quality is achieved for all domestic circuit breakers, our aim will be to work out general specifications for the application of the various types and models. This will be a great help to power station designers in making the installations more economical and reliable.

Summarizing the above, we present the following suggestions for prompt measures to be taken concerning our circuit breaker production:

1) The Bureau of Standards should issue new compulsory standards superseding the old standard drafts of 1956.

2) All the protective equipment currently produced for a 30-kilovolt nominal value should be immediately superseded by 35-kilovolt units.

3) All circuit breakers and their drives should be made adaptable for three-phase line-reclosure and out-in-out cycle switching. It is particularly urgent to develop a new motor-wound drive in conjunction with the OM type oil-free reclosing circuit breaker.

4) The 20-kilovolt open-air pole-mounted circuit breaker and its reclosing version adaptable for long idling cycles should be prepared for mass-production as soon as possible.

5) Primary cutoff switches should be desinged, tested, and manufactured with the following properties: independent characteristics, small leakage field, and short-circuit reliability.

6) Delivery conditions on circuit breakers should be reexamined and readjusted to more reasonable terms. We also suggest that our domestic supplies be made independent of exports; preparations should also be made for making more reserve parts available for replacement and repair.

7) Standard maintenance principles should be worked out by a committee of experts for the various circuit-breaker types.

8) An order should be issued for accurate statistical recording of breakdown cases at the power stations and other industrial establishments (mines, etc.), thus enabling the

manufacturers to better evaluate their products and improve on new designs.

9) Last but not least, we urge the establishment of a domestic short-circuit test station, without which our products will still be characterized by unreliability and delay in spite of the costly one-a-year test abroad.

Remarks

Jeno Lajthay, President of the Technical Receiving Bureau (Muszaki Atveteli Bizottsag):

First I shall deal briefly with the most frequent failures of medium-voltage circuit breakers at the OVIT[3] [National Electric Power Transmission Line Enterprise], and then I shall discuss the possible solutions of some of the principal problems in improving the quality of our products.

The failures I will cite first may not seem to be essential; however, from the maintenance viewpoint it cannot be ignored that apparatus breakdowns have represented 69 percent in 1957 and 57 percent in 1958 of all breakdowns recorded at OVIT stations.

Generally we have had good experiences with the OTKF 35/501 small oil chamber equipped circuit breakers. A frequent failure has been the slackening of the quenching chamber casting, mostly on circuit breakers cast with a sulphuric filling compound. Among the manufacturing and mounting mistakes, we could mention the complete lack of the breathing path normally provided for the expanding quenching chamber (the horizontal bore on the securing bolt of the upper breathing path was omitted or the boring was done at the wrong height). The casting which holds the lower poppet contact of the circuit breaker is porous in many cases, causing a constant oil leak.

The PTK 201 and 601 pneumatic circuit breakers usually work well, although sometimes we have encountered flash arcs through the textile-bakelite arms, as in the case of the power station at Sojtor. The new arms installed have a more favorable insulation resistance, higher than 1,500 megohms. The pressure-controlled capacitors on the MS 20 type of activator units have sparked through quite frequently; replace-

ment was a problem because this type had been discontinued long ago. In the same unit the slider on the activator level sometimes slips off the tip of the valve and does not release the valve when energized. The contact surface of the slider leaning against the value stud is too small; the abrasive wear of this surface creates a longitudinal force which tends to push the slider off the tip of the valve, resulting in faulty operation. In the receiving department we have rejected circuit breakers for other minor defects as well.

According to the reports, the R 624b and c expansion circuit breakers performed satisfactorily in the past two years. One of the major production mistakes was the improper formation of the poppet contacts, which impaired the lower contact-making, causing overheating and fusion between the contacts and leading to serious breakdowns. On the older types, the poppet contacts were made of brass or copper.

The newly introduced contact materials (carbide inserts) have a much longer lifetime. A further shortcoming is that the so-called head casting of the circuit breakers have not been adequately cleaned of the molding sand. Owing to the inevitable trembling during the operation, the sand grains have fallen into the mechanism, causing dirt deposits and "seizure." We have discovered defects on the lower activating hollow shaft of the circuit breakers as well, probably resulting from assembly mistakes. It would be desirable to seal the air cylinder or at least reduce the opening to prevent the entrance of foreign matter.

Although most of the above-mentioned deficiencies have already been corrected, instead of just curing symptoms we have to take comprehensive organizational measures to satisfy the demands of the power stations.

The fact that the projects of making the various larger electric machine types used by the power enterprises were assigned to one enterprise per type has proved very economical, although, owing to this monopolistic policy, some new deficiencies have developed, as follows:

In the lack of competition the factories have primarily served their own interests instead of that of their customers, the maintenance and operating enterprises. However, from the viewpoint of the national economy, supplying the power enterprises is more important than the production economy of any factory.

This monopolistic policy of the factories resulted in the fact that a tendency developed to replace customer acceptance inspection with technical certificates. It is evident that the quality control man supervised by the management--both having a financial interest in fulfilling the plan--will not judge the quality of the product as conscientiously as would a representative of the operating enterprise, whose interest lies in trouble-free operation of the same product.

If we really want to get to the core of the problem, we have to raise the question of constant supervision of the production which precedes the quality control. This method was adopted long ago in export orders and in most branches of machine production. So far, the electric power industry has been the only exception.

Cooperation between factories has been very poor in exchaning experiences concerning construction errors, corrosion, etc., although this should eventually be the basis of design improvements.

The factories are also poorly informed about the customers' requests resulting from the advancement of power installations and the increasing short-circuit power. For instance, at some OVIT substations the inadequate power capacity of the medium-voltage circuit breakers has delayed the installation of new heavy-duty transformers which would have met the increasing power needs by decreasing the electrical losses. According to the latest specifications, the 400 to 600 megavolt ampere circuit breakers are no longer suitable in conjunction with transformers rated at 36 megavolt amperes. If, for instance, we assume a short-circuit power of 250 megavolt amperes on the 120-kilovolt side of the power station, the short-circuit power is 728 megavolt amperes on the medium-voltage busbar of the two parallel connected 36-megavolt ampere transformers. Since the shoft-circuit power is constantly increasing on the nation's power mains, along with transformer capacities, the 1,000-megavolt ampere prototypes of the medium-voltage circuit breakers should have already been made available, of course with a reclosing option. If there were better cooperation between the factories and the operating enterprises, we would not have to fear that the economic advancement of the nation's power supplies would be hindered by a lack of appropriate medium-voltage circuit breakers.

Furthermore, the operating enterprises are not adequately equipped with technical instruction material, detail drawings,

and spare parts indispensable for proper maintenance. The inadequate part supply inevitably leads to the method of taking the necessary replacement parts out of otherwise finished and workable apparatuses.

The above-listed organizational deficiencies can be eliminated by the following measures:

- Introduction of production control
- Acceptance inspections according to the most rigorous standards
- Organization of exchange of experiences between the factories and the operating enterprises
- Assignment of product modification and development problems to the same department within a factory

Production control and acceptance inspections could be handled by a specially organized service group under the supervision of the OVIT and the five main rural power enterprises (as in the VIKASZ [not identified][3]).

The exchange of experiences could be undertaken by the Technical Acceptance Committee of the respective industrial branch, with the collaboration of factory delegates.

A special committee should be formed by the competent authorities of the Ministry of Metallurgy and Machine Industry and the Ministry of Heavy Industry (Nehezipari Miniszterium), with the occasional participation of certain research institutes. New designs and modifications of old types would not be permitted without the approval of this committee.

In arranging this meeting, the purpose of the Hungarian Electrotechnical Society (Magyar Elektrotechnikai Egyesulet) was to provide a forum for the nation's power distributing enterprises. The suggestions and recommendations of these enterprises will pave the way for future achievements based on their 15 years of technical experience.

Robert Bakos Szabo, Associate Scientist of the Electrical Power Research Institute (Villamosenergetikai Kutato Intezet)

It is a well known fact that the cutoff power of high-voltage circuit breakers is considerably influenced by the voltage present at the moment of cutoff between the circuit

breaker terminals. This voltage has been called recurrent voltage, according to the MSz 1589 T standard draft entitled, "High Voltage Circuit Breakers." The recurrent voltage has two compoɾents--recurrent voltage of the operational frequency and superimposed transient voltage. Thus, the time function of the resultant recurrent voltage is determined by both the power line and the circuit breakers. It is useful to separate the two factors in our investigation; in the first step it is also customary to ignore the effect of the circuit breakers. In this case we might speak of "independent recurrent voltage," which is exclusively determined by the line parameters--inductance, capacitance, and resistance. We assume that in the line section being examined an ideal circuit breaker is working, which produces a zero arc voltage; the aftercurrent is also zero after the cutoff, which occurs exactly when transiting the zero line.

The independent recurrent voltage determined by the line parameters at the location of any of the line's circuit breakers is among the major characteristic data to be considered in selecting a circuit breaker. At these points, the independent recurrent voltage cannot be more than the specified maximum characteristic recurrent voltage of the circuit breaker.

The recurrent voltage is usually expressed in terms of the transient frequency determined by the line's resonance frequency. However, this figure alone does not fully describe the recurrent voltage and the circuit breaker's capacity limit. We therefore have to consider another parameter: the peak factor, which is the quotient of the maximum recurrent voltage and the peak value of the line resonance frequency component. In the case of an ideal circuit breaker with no attenuation, the peak factor is equal to 2. Considering the ever-present resistance--thus a finite attenuation on the line--the peak factor is always less than 2. In most cases it falls between 1.4 and 1.6--very seldom to 1.8.

The recurrent voltage can also be described by the recurrence speed expressed in volts per milli-second. Physically, this represents the spped of the voltage recurrence between the circuit breaker terminals. Neither the resonance frequency nor the recurrence speed cano fully describe the behavior of the circuit breaker except in the special case where we ignore the attentuation--namely, the series and parallel resistancøs in the network. In this latter case, the peak factor is 2. Naturally, the resonance frequency can be con-

verted to recurrence speed and vice versa. We also have to assume in the above case that only one frequency is present on the line. In most cases, however, line measurements are carried out in the presence of more than one frequency. In this case the graphic method is very helpful, as described in the standard draft MSz 1589 T entitled, "High-Voltage Circuit Breakers." This method is identical with that specified by the International Electrical Commission, providing a graphic process to replace multi-frequency or even aperiodic curves with equivalent single-frequency curves. In our practice we accept the definition described in the above-mentioned standard draft. The resultant equivalent curves in turn are characterized by either the peak factor and the resonance frequency or the peak factor and the recurrence speed.

What is the actual purpose of measuring the recurrent voltage from the viewpoint of the line or the circuit breakers? It is known that the cutoff power of a circuit breaker, as a function of the recurrent voltage parameters, has decreasing characteristics--a high peak factor and a high resonance frequency is always accompanied by a lower cutoff power. This means that when the safety factor of the recurrent voltage is increased, the circuit breaker's cutoff power decreases. The function between the recurrent voltage and cutoff power should be plotted on an experimental basis. However, this work can only be accomplished at a short-circuit test station (probably to be erected in Zuglo[3]), which would make it possible to record the above-described characteristics of domestic circuit breakers.

We must also know the characteristics of the line itself--in other words, the recurrent voltage parameters of the planned circuit breaker locations, in the case of two different line configurations. One of these should occur when the short-circuit power is at its maximum, the other when the recurrent voltage parameters are at a maximum. With the aid of the line and circuit breaker characteristics, we should be able to select a circuit breaker for any specific point of the line, and if this circuit breaker can withstand the applied stresses, we can assume that it would stand up equally well under similar conditions in the field.

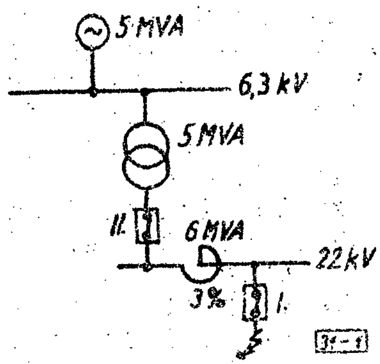
In measuring the recurrent voltage, the most popular method is the so-called direct method. In determining the recurrent voltage, the simplest procedure is to take oscillograms from the momentary voltage response present between the circuit breaker terminals, at the moment that the short-

circuit is being disconnected from the line. No special equipment is needed for this experiment. We have to establish short circuits at predetermined points of the line and then remove them, with the circuit breaker inserted in the point to be investigated. By this method we can measure the actually present recurrent voltage, determined by both the line parameters and the specific circuit breaker. This voltage is affected by the circuit breaker; thus, it is not the same as the independent recurrent voltage generated by a fictitious ideal circuit breaker in the same point of the line. Thus, we would measure different recurrent voltage parameters with different cicuit breaker types in the same point of the line and with the same network configuration. It would be more practical to measure the independent recurrent voltage, because this component represents the load toward the line. However, the direct method is usually preferred because of its extreme simplicity, in spite of the obvious obstacles present in the application. The conditions should be carefully weighed because the application of short circuits on a line always constitutes a risk. Short-circuit tests are therefore used very seldom on operational lines. On the domestic lines the permissible highest load of the transformers limits the use of short-circuit tests. Experience has shown that this value is approximately 3 to 3.5 times the nominal load current; to hold the current at this permissible value, suitable line impedances must be inserted. This proves that direct short circuits cannot be used. Naturally, the results obtained correspond to the short-circuiting impedance and not to the live power line. From this it is obvious that an operational line cannot be "mapped" by establishing direct short circuits. However, the direct method is very useful in evaluating the results obtained by other indirect methods. No matter which type of measurement we choose (injecting method, resonance method, breaking of small currents, etc.), the application of each test is considerably limited. Extensive and true recurrent voltage tests at every planned circuit breaker location can only be carried out on reduced scale models.

As for our conclusion, we can see that circuit-breaker characteristics can be measured only at a high-power short-circuit test station; line characteristics, however, can be obtained almost exclusively on reduced-scale models. Our sincere hope is that both the test station and the model will be available within the next two years, whereby the systematic work of determining recurrent voltages can be started soon.

The Electric Power Research Institute has already conducted occasional measurement to determine the recurrent voltage parameters. Since the results of these measurements have not yielded a general solution, we therefore present here a description of two actual tests.

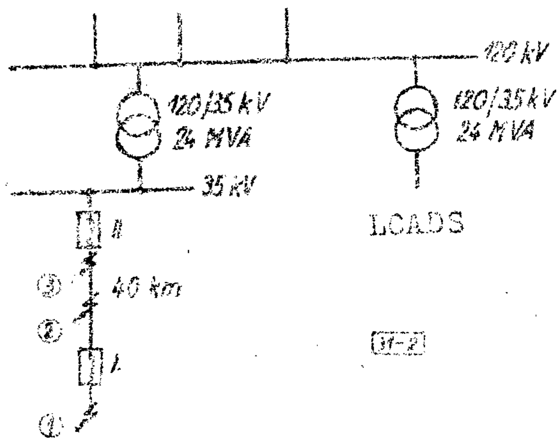
The measurement shown in Figure 1 was made in a small power plant by disconnecting direct short circuits; the second measurement (Figure 2) was carried out on one of the 120/35 kilovolt substations with the injecting method and by disconnecting indirect short circuits. We must note that the line voltage was removed during the application of the injecting method.



Three-Phase Short Circuit Type	Disconnected by Circuit-Breaker	Resonance Frequency (Herz)	Peak Factor C	Measuring Method
Grounded	I	9,700	1.3	Direct
Ungrounded	I	14,600	1.35	Direct
Grounded	II	9,500	1.35	Direct
Ungrounded	II	11,000	1.3	Direct

Figure 1

Measurements Made in a Small Power Plant by Disconnecting Direct Short Circuits



Location of Three-Phase Short Circuits	Disconnected by Circuit-Breaker	Resonance Frequency (Herz)	Peak Factor C	Measuring Method
1	I	1,160	1.4	Direct
1	I	1,200	1.5	Injecting
2	II	3,940	1.43	Injecting
3	II	11,200	1.25	Injecting

Figure 2

Measurement by the Injecting Method in a 120/35 Kilovolt Power Substation by Disconnecting Indirect Short Circuits

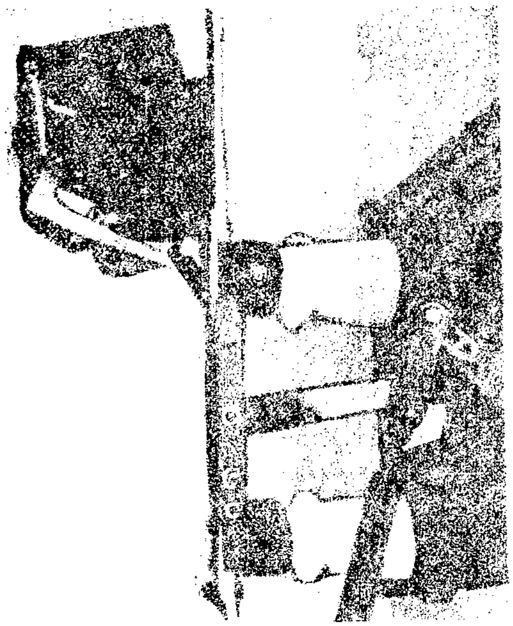
Endre Rusznyak, Group Leader, Scientist of the Research Institute for the Electric Industry

At medium-voltage transformer substations it is not economical to install individual circuit breakers on the less important line branches. Short-circuit protection can also be handled by automatic protectors, which are less expensive and are readily available. We have always used circuit breakers wherever the load current was more than 5 to 10 amperes because a higher current cannot be disconnected by sectioning switches.

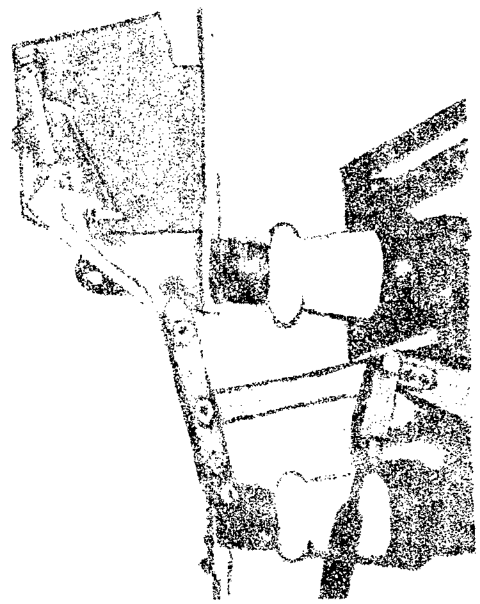
The Research Institute for the Electric Industry developed a sectioning switch years ago, whereby it became possible to break 250 amperes on a 10-kilovolt line or 150 amperes on a 20-kilovolt line. In the quenching chamber of this sectioning switch, the thermal effect of the arc triggers a strong gas flow generated by two special plates.

Photos 1-4

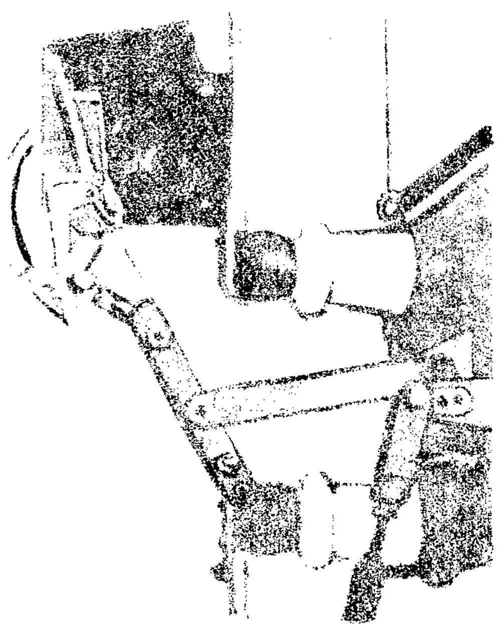
10-Kilovolt 250-Ampere Sectioning Switch



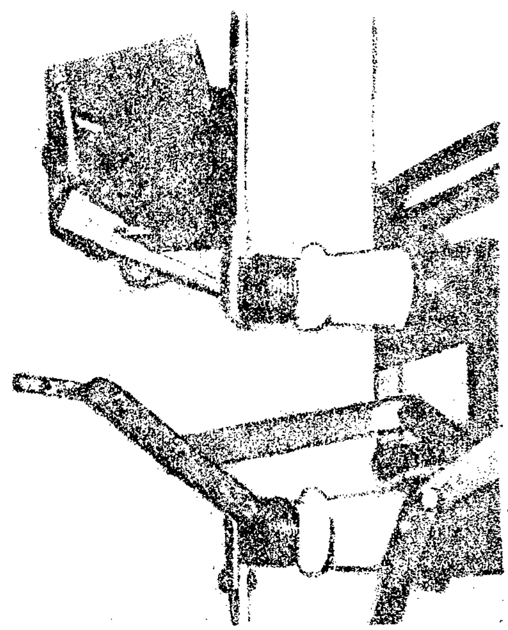
One pole in closed position; no current flowing through chamber



One pole in starting position; current passing through chamber



One pole halfway open; sickle-shaped auxiliary nife snapped out; current interrupted



One pole is fully open; driving level and auxiliary knife returned to original position

This gas flow, in turn, suppresses the arc. The mass production of this switch, although started, had to be discontinued because efforts had failed to produce the planned gas generating material in a sufficient mechanical stability and durability while still keeping its gas-generating capacity.

Last year the Research Institute revised the project by remodeling the quenching chamber while keeping the basic principle intact. Through these changes, the gas utilization has been improved to such an extent that the commercially available and mechanically stable plexiglass could be used as a gas-generating material. A whole series of tests has shown that 250 amperes at 10 kilovolts or 150 amperes at 20 kilovolts can bw regularly interrupted (assuming cos = 0.2); the switch works equally well with 320 amperes at 10 kilovolts or 180 amperes at 20 kilovolts. In practical cases, cos = 0.7, which cuases the current to rise even higher than the above values. An arc lasts about two to three half-cycles.

The sectioning switch can easily be converted to switch capacitators as well; only an insulated extension has to be mounted onto the sectioning knife, which carries a properly designed wire-wound rheostat. This way the sectioning switch works as a step switch for every connection and disconnection.

The shock strength of the new sectioning switch is very similar to that of the previously mentioned type with the newly added quenching chamber.

The sectioning switch does not represent a problem in short-circuit protection because neither in closed position nor during the closing period does any durrent flow through the chamber. In order to prevent accidental closures in the presence of a short-circuit load, the drive should contain some spring action. This way the switching speed will be independent of the operator and still be enough to prevent excessively high short-circuit currents. Phase-separating plates can also be mounted on the chamber for further safety.

From the operational viewpoint, the sectioning switches must work reliably and safely, not only in continuous operation but also, after a year of inoperation, the first switching should still be perfectly successful. The advantage of the above-described sectioning switch is that the mechanism can also be checked by a manual switching lever while the power is on.

The gas-generating plates might wear out, become sooty, or even be totally used up if exceptionally heavy currents are frequently switched. The sooting does not have any importance because the circuit will also be interrupted outside of the chamber a few cycles after the arc has been suppressed. The wear is not significant either; it is almost negligible, even after interrupting the above-mentioned heavy currents 60 to 70 times. Smaller currents do not affect the material; neverthless, the plates can be replaced if necessary.

In our opinion, a considerable amount can be saved in designing new stations by the use of this new device. The pilot run of 50 to 100 units will be finished this year; after further tests it will soon be commercially available. It will be produced in the Electrical Plant of Baja; however, to gain some pre-production maintenance experience, the Research Institute will make three triple-pole 10-kilovolt sectioning switches during the pilot run.

Footnotes

[1]This article contains the material presented at the convention held on 25 March 1959 with the collaboration of the Hungarian Electrotechnical Institute, Electric Power Division (Magyar Elektrotechnikai Egyesulet Villamosenergia Szakosztalya) and the Research and Design Enterprise of Electric Networks (Vilamos Halozati Fejleszto es Tervezo Vallalat), entitled "Production, Development, and Operating Problems of Domestic Medium-Voltage Circuit Breakers.

[2]Transformer and Electric Apparatus Plant (Transzformator-es Villamos Keszulekgyar).

[3]Zuglo is one of the districts of Budapest.

[4]Material Supplies of Electric Enterprises (Villamosenergiaipari Vallalatok Kozponti Anyagszolgalata).

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HUNGARY

Data on Hungarian Light Industry

[This is a translation of an article by Mrs Jozsef Nagy, Minister of Light Industry, in Belpolitikai Szemle, Vol II, No 12, December 1959, Budapest, pages 17-21; CSO: 3531-N]

Light Industry and the Production Competition in Honor of the Seventh Party Congress

The 1959 production volume of light industry was planned under unfavorable conditions. The domestic commercial network was well stocked with clothing, and there was a temporary slump in the demand for light industry products. The Council of Ministers (minisztertanacs), therefore, set the 1959 production quota of light industry only 2.2 percent above that of the preceding year. Most of this increase was planned in the furniture, paper, and printing industries.

Thus, in the production competition launched after the' March resolution in honor of the coming Seventh Party Congress, pledges to increase the production volume were made only in the aforementioned three industries and in the household fabrics industry. Pledges in the other industries aimed to surpass the export quotas, to improve quality, and to reduce production cost.

In April and May 1959, however, a significant change occurred. The demand rose and both the domestic and the foreign trade organs requested light industry to produce more goods over and above the planned quotas. Accordingly, the competitive spirit among the workers could be directed toward the quantitative overfulfillment of the production plans. In order to increase their production, the light industry plants increased their labor force, often excessively. This was one of the reasons that the indices for labor productivity and profits were low in the first half of 1959.

The labor competition launched in the honor of the Seventh Party Congress played an important role in our ability to surpass the production quota for the third quarter of 1959 by 7.8 percent. Production rose about 11 percent over the same period in 1958. The overfulfillment of the plan was higher than average in the clothing, paper, dry goods, and furniture industries. The Red October Men's Clothing Factory (Voros Oktober Ferfiruhagyar), for example, surpassed its labor competition pledge of 8 million forints by 2 million. In the labor competition the factory manufactured nearly 14,000 suits more than what its production quota required. The Cardboard Factory (Kartonlemezgyar) fulfilled its labor competition pledges by 28 September 1959, increasing its output by 1,000 tons of paper. The Cotton Factory in [Pestszent-] Lorinc (Lorinci Vattagyar) surpassed its annual production plan by about 3 million forints. The Furniture Factory in Ujpest (Ujpesti Butorgyar) pledged 22 percent of its annual output and manufactured, among other things, 1,046 bed-sitting room cabinets for the labor competition.

As a result of the large-scale expansion in the third quarter of 1959, in the first eleventmonths we were able to surpass by 4 percent the [pro-rated] production quota established by the Council of Ministers. This 4-percent overfulfillment amounts to 588 million forints (computed at stable prices). This means that we had surpassed our 400 million forints of pledges by 188 million forints even before the Congress convened. The workers' enthusiasm during the competition proved that they were capable of achieving more than what the enterprises had originally pledged. The labor competition is continuing at the same rate. In contrast to the 2.6 percent pledged, we will foreseeably surpass our annual production quota by 4.5 to15 percent--i.e., by about 700 million forints.

In the labor competition the paper industry produced 4.000 tons of paper over and above its production quota. The furniture industry supplied the population, among other things, with an additional 3,200 cabinets, 2,500 pieces of upholstered furniture, and about 7,000 pieces of bentwood furniture.1 The clothing industry supplied 158,000 items of clothing over and above the plan. The shoe industry supplied the population with an extra 343,100 pairs of shoes.

The enterprises of the flax, hemp, wool, silk, dry goods, paper, and furniture industries fulfilled their annual labor competition pledges in the first nine months, but even the

cotton, knitwear, and shoe industries fulfilled their pledges without failure. It should be noted that in general our export plans were also surpassed. Thus, for example, in the third quarter of 1959 we supplied the foreign trade network with 19 percent more cotton cloth, 23 percent more woolen cloth, and 26 percent more knitwear than had been planned. In the competition the production quota of the state local industry was exceeded by 100 million forints' worth of goods and that of the cooperative industry by 323 million forints' worth.

Variety and Serial Production

In the spring of 1959 there were many newspaper articles complaining that some product or other was not available and that certain products or certain varieties of goods were not manufactured at all. Although articles of this kind no longer appear, some customers still raise these questions. The factories of light industry can manufacture only what the domestic- and foreign-trade organs order. This rule is scrupulously observed.

In the first quarter of 1959, owing to the absence of orders for goods in large series, the light industry enterprises were willing to increase the variety of the products, even though this did not involve large-scale serial production. Large factories were willing to accept orders for 150 meters of cloth or for 20 to 50 coats or cardigans. Aside from the fact that orders for goods in small series does not really insure a greater selection, production on such a small scale affects production costs and labor productivity very unfavorably. A wide selection is essential and indispensible because a high standard of living is reflected not only in the abundance of goods but also in their wide selections. Production cost, however, cannot be overlooked. The cost of production in small series is comparatively high. This in itself would be irrelevant from the point of view of supply, but production in small series slows down the production process and the supply volume drops. This was the situation, for example, in the knitwear and shoe industries. In the first months of 1959 they suddenly increased the variety of their products and had considerable difficulty in fulfilling their production quotas.

The national economy can afford to increase the variety of its production only to a certain extent, because this is primarily a question of cost and productive capacity. For this reason we must reproach the textile factory which manufactured different varieties of cloths in lots of 150 meters each. The same applies to a clothing factory which manufactured 50 coats of one type. What would happen if we were to permit our large textile factories to manufacture only 150 meters of one variety of cloth? Production would decline and shortages would develop, because it would be impossible to supply each of the more than 300 yardgoods retail stores with even one meter of cloth each.

Naturally, small lots and exclusive items are necessary, but their production should be lift to the plants of the local councils and cooperatives--not to the large factories. On the other hand, however, the cooperatives should not strive to go into serial production. This situation must be urgently remedied.

The Truth about "Uniforms"

Certain daily papers also demanded that the clothing industry discontinue production in large series because the clothes are allegedly becoming uniforms.

How true are these charges? The clothing industry manufactures a maximum of 5,000 pieces of one and the same model. Men's suits come in 16 to 20 sizes, women's dresses in 9 sizes. Series of 2,000 suits or dresses are more common, although the clothing industry exceptionally manufactures as few as 500 if the commercial network so desires. If we take into consideration that in Hungary there are 9,000 retail clothing stores, it is immediately evident that the series are not high. For example, if 2,000 coats are distributed among the 9,000 retail outlets, the average is one coat for every fourth store. Thus, it would be more accurate to say that the coat is a scarce item. If someone buys this coat in the fourth store, he will certainly not feel that he is wearing a uniform.

Otherwise the clothing industry provides the domestic commercial network with 800 new models each year.

Once Shortage Items, Now Mass Goods

Despite the existing difficulties, the other branches of light industry have also increased the variety of their products and during the year have done everything possible to eliminate the so-called shortage items. In the knitwear industry, for example, gym suits were a so-called shortage item. In comparison to 1,400,000 gym suits sold in 1958, 2 million are being sold in 1959, in a considerably wider selection. Gym suits for children are available in 13 to 15 models. In order to eliminate the shortage in rayon and nylon underwear, the Knitwear Factory in Pesterzsebet (Pesterzsebeti Kotottarugyar) was reorganized and modernized. In comparison to 1958, the output of rayon underwear increased 40 percent and that of nylon underwear, 21 percent. The output of banlon sweaters has also increased, but the volume of sweaters made of wool-like synthetics (orlon, dralon, and terylen) has dropped somewhat.

One of our most sought products is shoes. In 1959 the shoe industry is better able to keep abreast of the demands and manufactures more of the popular spike-heeled shoes in good quality and at prices the consumers are able to afford. Shoes made of pressed and split leather are also popular. We have started the production of women's sport shoes and of "little mother" shoes with higher heels. One of the major goals of the shoe industry is to end the just complaints about the quality of children's shoes. The variety of shoes has been widened with light sewed and glued men's shoes, the so-called "ballerina" shoes for girls, cheap unlined sandals, and high-heeled sandals.

The wool industry in 1959 presented the commercial network with more than 2,000 fabric patterns and has considerably increased the output of upholstery fabrics (formerly a shortage item), making them more durable through the addition of synthetic fibers. The consumers are also able to purchase considerably more napped upholstery fabrics.

The 1960 Plan of Light Industry

The 1960 production plan of light industry is tentatively 7.7 percent above the output expected for 1959.

The increases in production volume are above average in the wool industry (111.7 percent), the dry goods industry (116.3 percent), the paper industry (110.2 percent), and the clothing industry (111.4 percent). In comparison to 1959, the 1960 plans call for increases of 2.9 percent in cotton cloth production, 4.8 percent in flax and hemp fabrics, and 3.9 percent in silk cloth production. The production of knitwear will increase 6 percent, that of shoe production 8.4 percent.

The 8.5-percent increase in furniture production is especially significant in view of the fact that many of the factories have already been working double shifts in 1959.

The printing industry in 1959 surpassed its 1958 output by 11 percent. A further increase of 8.2 percent is expected for 1960.

In all, light industry will supply the domestic commercial network with approximately 7 percent more goods in 1960 than in 1959. The foreign trade organs, however, will get somewhat less than the previous year.

The plans call for a substantial increase in the ratio of finished consumer goods. Instead of yard goods, for example, more clothing will be manufactured, etc. Thus, the additional labor will increase the value of the production volume.

We will also increase the production of domestic industrial materials. The output will increase 10 percent in finished hemp products, 20 percent in finished flax products, 23.7 percent in chipboards used in furniture production.

In comparison to 1959, the 1960 plans call for a 2.9-percent rise in labor productivity. The production costs must be reduced by 1.3 percent.

The allotments for expanding production and raising its level are considerably higher than they were in 1959. Construction work on our foremost investment project, the Danube Cellulose Factory (Dunai Szalmacelluloz-gyar), is proceeding at a rapid rate. The installations are being supplied by foreign companies.

The investment projects for 1960 include the automation of the cotton mills. The plans call for the installation of automatic looms in the Kispest Textile Factory (Kispesti Textilgyar) and the Kobanya Textile Factory (Kobanyai Textilgyar).

These projects will improve the heretofore neglected level of automation in the cotton mills. In order to satisfy the increasing demand for worsted cloth and for knitwear made of combed yarn, the wool industry will be equipped with combing installations. In most industries substantial amounts will be spent for reconstruction.

In sum, the most important task of light industry in 1960 will be to increase its output in order to satisfy the population's rising demand to a maximum extent. No further general improvement can be planned with respect to quality and variety, because this would tax the national economy with additional investments totaling several hundred million forints. At the same time, however, everything will be done to maintain the wide selection and good quality achieved in 1959.

Light Industry and the [Second] Five-Year Plan

In comparison to 1958, production must be increased 32 percent in the textile and shoe industries, 75 percent in the printing industry, and nearly 100 percent in the furniture industry. Paper production will also be doubled. A total of 400 million forints will be allotted for the modernization of the printing industry, and a modern book publishing plant will also be built.

In every branch of light industry considerable progress will be made in supplying the population's increasing demands. Thus, for example, the per capita consumption will be increased by 14 percent in the cotton industry, 6 percent in the wool industry, and 22 percent in the silk industry. The increase planned in the [per capita consumption of] knitwear is 14 percent. The per capita consumption of synthetic hosiery will be nearly doubled. The planned increase in the per capita consumption of shoes and leather goods is 11 percent.

Our primary task in working out the plans is to substantiate the indices with further economic analyses and, out of the many variations, to select for development the ones that are the most economical. We must reckon with the possibility that we might find more economical solutions by the time the ones that now appear to be the most economical have been completed.

Under the [Second] Five-Year Plan we must make considerable progress in raising the technical level of light industry. In accordance with the directives issued by the Party, therefore, light industry must be developed primarily through the modernization of the existing industrial plants rather than through the construction of new ones.

The plants and workers of light industry will do everything in their power to fulfill without failure the tasks assigned them by the Seventh Party Congress.

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Economic Evaluation of Industrial Price Adjustments

[This is a translation of an article by Bela Csikos-Nagy, President of the National Price Bureau, in Figyelo, No 2, 12 January 1960, Budapest, pages 3-4; CSO: 3597-N]

A year has elapsed since the general adjustments of the industrial producer prices, construction industry unit prices, freight rates, and commercial prices margins. In general, the adjustments were made in a well-organized and suitable manner. The usual difficulties which are inevitable in price adjustments of this scope were basically overcome by the middle of 1959.

Favorable Effects on Production and Planning

The financial reports of the enterprises for the first half of 1959 indicate that the primary aims of the price adjustments have been achieved to satisfaction. Under the previous price system, the relations between production costs and price proceeds developed differently in the A and B sectors of industry. Within the A sector, the price levels in the mining industry and the metallurgical industry and timber output were 40 percent below the production cost levels, while in the other branches of industry the average price levels were 30 percent higher than the production costs. These disparities have been eliminated. In the industries operating under the jurisdiction of the ministries, the producer price levels were raised 61 percent, including a 98-percent increase for the A sector and an 18-percent increase in the B sector. The abolition of the price subsidies for domestic raw materials and the assessment of the imported material and fixed capital in accordance with the new prices has resulted in a new uniform industrial price structure. In this new price system the price levels within the various industries are distributed fairly evenly, at an average of 12 percent above the production costs.

The introduction of the new industrial producer price system has proved favorable for the socialist management of the national economy. Thus, the price system has produced significant changes in the results of the enterprises. In view of the fact that our national economy has a shortage of raw materials, we have been able for the first time to base the separate financial management of our enterprises on prices that fairly accurately reflect the costs of the available materials which we manufacture (import). The new materials prices have altered the cost structure of industry. In most branches of industry, the cost of materials has increased while the cost of labor has dropped. As had been expected, the workers' direct financial interest in cutting the production costs (i.e., in higher profits) led to a more economical use of materials in 1959 than in years past. The industrial enterprises that are heavy consumers of coal have endeavored to obtain coal varieties from which they can obtain the required caloric value at a low specific cost. Since the second half of 1959, the aims outlined in the adjustment of the power rates--i.e., the better utilization of the generating capacity, and the reduction of outlays for the power industry--are beginning to materialize. The enterprises have endeavored to observe their consumption plans and to use less power during the peak load periods. Power-factor condensors are being installed at a rapid rate. In the machine industry the exaggerated specifications for metallurgical materials are being revised, etc.

The purpose of the price adjustments was to combine the economical utilization of materials with good quality, not only in the consumer enterprises but in the ones that make these materials as well. The coal prices based on caloric value and ash content serve as incentives in the mining industry to mine pure coal and to sort out the slag. Since 1959 the machine industry has not paid for the excess weight of the castings and forged shapes. Thus, the metallurgical industry is making a greater effort to observe the specifications. The fact that, within the volume of timber cut, the ratio of industry timber is systematically rising can be attributed largely to the price system of the lumber industry.

Efforts to coordinate the price ratios of the mutually substitutive materials with the available resources of the national economy have already produced a noticeable effect on the planning institutes and on the designing bureaus and sections. Especially important with respect to the designing of machine industry products are the new price ratios of cast

metals, steel alloys, light metals, and synthetic metals. In machinery designing the price ratios of the mutually substitutive materials always determine the optimum ratio that ensures the best relations between weight and performance characteristics. It is no longer profitable to substitute cast metals for steel alloys if this affects the modernness of the product. The possibilities of using light metals (aluminum) instead of heavy metals have increased. The new price ratios have increased the financial interest of the enterprises in the utilization of synthetic materials.

Another important goal of the price adjustment was to make the organization of production within the enterprises more economical. The specific amount of labor and time required for piece production is several times higher than in the case of serial production. Despite this fact, the designing bureaus in years past often resorted to solutions that involved piece production, which could have been easily avoided. We wished to curb such practices through the wider application of surcharges based on the quantities ordered. The effects of this policy were already evident in 1959.

The effects of the prices should not be examined merely from the point of view of enterprise economy. In a socialist country the prices also affect planning and organization. Fortunately, in 1956 the National Planning Bureau (Orszagos Tervhivatal) had already worked out the prices of many materials and semifinished products, on the basis of their construction costs. Within the limits of the existing possibilities, the conclusions derived from these price studies could be utilized in long-range planning. It may be worth while to cite several examples to illustrate the relations between prices (production cost) and long-range planning. The directives for the [Second] Five-Year Plan call for considerable changes in the structure of the fuel plan. The demand for fuel will rise 32 percent, but the ratio of coal in proportion to the total fuel supply will drop from 78 to 69 percent, and the percentage of coal used for power generation will increase from 36 to 44 percent. These structural changes in the power-supply plan are based, among other things, on the findings that the production cost of coal is 20 to 25 percent higher than that of petroleum (and also of fuel oil); that, owing to the natural conditions of our coal deposits, the opening of new coal mines will foreseeably increase rather than reduce the specific production cost of coal; and that the efficiency of coal is higher if it is used to generate electricity than when it is used to produce steam in the boilers of the industrial plants.

The directives for the [Second] Five-Year Plan also call for changes in the structure of the materials used in production. The consumption volume of industrial material will increase 44 percent, but within this the volume of synthetic materials will increase to four times the present volume. The rapid expansion of the industries that manufacture and process synthetic materials is based, among other things, on the realization that synthetic materials can be widely used as substitutes for the traditional materials that are difficult to obtain, and that the production (import) costs of the synthetic materials are considerably lower than those of the latter. In years past the long-range planning of the processing industries could not be based on a detailed knowledge of the domestic production cost. But the directives of the [Second] Five-Year Plan make it possible to take the experience of the recent price adjustments into consideration in the present elaboration of the detailed plans, as has already been done in certain industries--for example, in the food industry, chemical industry, etc.

The price adjustments have also affected the work of the individual ministries. The studies undertaken by the Ministry of Foreign Trade (Kulkereskedelmi Miniszterium) on the economy of more than one thousand export items may be regarded as a considerable advancement. The results of these studies are being used in planning the foreign trade structure for 1960.

Still Unsolved

The new price adjustments, however, also have certain shortcomings. An accurate description of these shortcomings is rendered difficult by the fact that the representatives of the government organs participating in the economic evaluation of the new price system analyzed the new prices from different points of view and on the basis of different requirements. In view of the limited space available, I am able to point out only one controversy. In the economic evaluation of the industrial price adjustment it has been pointed out that the profits included in the prices are not proportionate; consequently, the incentives provided by the prices will distort the development of socialist production. It must be admitted that the even distribution of [production] profits was not and could not have been included among the goals of the price ad-

justments. Uniform and proportionate prices necessarily involve a certain profit dispersion according to enterprises and products. The purpose of the price adjustment was to ensure that the profit dispersion was based on uniform (proportionate) prices. Only on the basis of such prices can the profit dispersion among enterprises reflect the differences in their technical and economical levels or the profit dispersion according to the products of the same industry reflect the differences in the production conditions for the various products. Thus, the profit dispersion cannot be regarded as a shortcoming of the new industrial price system. But it is a shortcoming in that the prices are not uniform (proportionate) in every branch of industry. It is characteristic of every period (thus, also of the period on which the price adjustments are based) that the production structure includes new products with comparatively high production costs as well as products that have been manufactured at comparatively low costs for some time. Our new price system partially reflects this inequality in the production costs of the new and the old products. It is not be accident that in certain industries the prices introduced in 1959 include comparatively higher profits, primarily for those products whihh were manufactured gor the first time in 1956 or thereafter. This present shortcoming of our price determination also expaains why the enterprises prefer to replace their old products with new ones, e en though such changes are not justified with respect to design, usefulness, or other significant characteristics.

Government Resolution Concerning Certain Corrections

The major shortcoming of the price adjustment is that we are unable to achieve a maximum coordination of the prices and their production cost. Had we known at the time of the price adjustments the exact volume, composition, and conditions of our 1959 industrial production, we would have set the price level about 5 percent lower (computed noncumulatively). In other words, we would have computed 4 percent less profit and one percent less tax on the production cost. The somewhat high producer price level was caused mostly by the fact that in the 1956-1959 period the production costs were cut by more than had been foreseen. Certain technical shortcomings of the price adjustments were also a contributing factor. The indices which the National Planning Bureau issued for converting the 1956 production costs were somewhat higher than

necessary. The cost calculations of the ministries (enterprises) were often lax. Such laxities are especially significant in those industries where not only the prices but also the methods for their determination have changed (the metallurgical industry, power industry, etc.). The Ministry of Finance (Penzugyministerium) often deemed it necessary to maintain the taxes that raise the price level. In the economic evaluation of the price adjustment, not only the price level but also certain prices (price ratios) were criticized.

The government adopted a resolution to eliminate the shortcomings of the price adjustments and to perfect the new system of industrial prices. In view of the fact that the analysis based on the industrial balance for the first half of 1959 does not provide an adquate basis for modifying the prices, the government stated that at the end of 1959 only those prices (price ratios) might be changed for which it could be unambiguously established that their economic effects were in conflict with the interest of the national economy. Accordingly, we have revised the turnover tax of the local industries, effective 1 January 1960. In this manner we wish to ensure that the turnover tax of the cooperative industry is commensurate with the net profits included in the prices. We have also revised the rates of the printing industry. In the various industries we have modified the prices of certain products.

The government instructed the National Planning Bureau to make a complete analysis of socialist production and distribution, on the basis of the industrial production balance for 1959 and of the cost analyses made in retrospect. These analyses will serve as the basis of the 1960 government measures concerning producer prices. According to the government resolution, no large-scale adjustments should be made in the producer prices merely because the average profits included in them are higher than had been planned. But, on the other hand, it is necessary to adjust the tax subsidies and the producer prices of the subsidized consumer goods to the actual production costs. This measure will reduce the present number of subsidized consumer goods. Owing to the unjustified high producer price level, the government has also been subsidizing consumer goods whose prices include profits higher than the subsidies themselves.

In connection with the price determination of certain, mostly foreign, machinery and parts, it has been requested that the producer prices be determined not on the basis of the cost

of the supplementary domestic production but on the basis of the import costs.

The effects of the technical development fund [within each enterprise] are also favorable. Owing to the difficulties connected with its introduction, a complete evaluation of this system has not yet been possible. According to certain indications, however, it will be desirable to increase the technical development funds at the expense of the [enterprise] profits and to introduce this system in transportation as well.

The Stability of the Producer Prices

In the course of the economic evaluation of the price adjustments, several questions were raised which are connected not with the adjustments but with the mechanism of price determination. One such question was whether our interpretation of the principle of producer price stability was correct.

At present the official determination of producer prices involves general price adjustments at certain periods, while in the comparatively long intervals between these periods basically only the prices of the new industrial products are determined. Thus, in the interval between two price adjustments the producer prices do not react to the systematic changes in the productivity of labor. Consequently, we are obliged to deduce the changes in production cost from the amount of the profits included in the prices.

But it is quite a different thing to express in the prices the changing production costs than to deduce them from the profit trends. In changing the prices, the changes in the production costs are studied separately for each product. The development of the profits included in the stable prices, on the other hand, reflect the changes in production conditions during the various phases. The price can effectively serve as an incentive and an expression of value only if it follows the permanent changes in values and economic conditions. For this reason the government has ordered a study of feasible methods that would permit at comparatively short intervals the periodic revision of the producer prices, and their modification if necessary. In view of the fact that prices are used as indices in planning and accounting, such a modification of the system of price determination requires the development of suitable methods in these fields as well.

In the course of the economic evaluation of the producer price system, special importance was attached to the price determination of the new industrial products. The investing agencies, particularly the Ministry of Foreign Trade, are not satisfied with the determination of a single price per product. Their objection is that quality deterioration is still possible, and that the enterprises are still able to ensure their profit in this manner. It was noted that very often the new industrial products are introduced solely for the purpose of ensuring higher profits by replacing one product with another, and not for reasons of wider selection or product development.

This brief and by no means complete outline reflects the multilateral tasks required to improve price determination and to further strengthen discipline in the calculation of prices and production cost.

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RUMANIA

Mechanization of Jiu Valley Mines

[This is a translation of an article by Tr. Birsan and Alex Miclea in Revista Minelor, Vol X, No 10, October 1959, Bucharest, pages 413-422; CSO: 3370-N]

To illustrate the increase in the supply of equipment for the mechanization of labor underground, we shall give a few examples:

The number of drag conveyors quadrupled in 1958 as compared to 1950, and was 10 times that of 1938.
The number of tubular ventilators in 1958 was four times the 1950 figures and 29 times the 1938 figure.
The number of locomotives was five times as much in 1958 as in 1950.

Considering the development of mechanization in the over-all work of coal extraction, it is possible to maintain that the level of mechanization is twice as high in 1950 and 4.5 times as high in 1958 as it was in 1938.

Use of Electric and Pneumatic Power. The aggregates and installations at the Jiu Valley mines are driven by electric and pneumatic power. Of the total electric power consumed, about 60 percent is used for the production of pneumatic power.

Electric Power. The main feeders in the national 35-kilovolt system and in the plant installations, of 15 and 6 kilovolts, are interconnected in the main collection and distribution station, from where 6-kilovolt lines extend in such a manner that each bar and each exploitation contains at least two electric power transmission points, thereby assuring continuity of transmission in case of breakdown.

Taking into consideration the great voltage of the national system as well as the relatively short distances from the central power stations, the short-circuit voltage on the 6-kilovolt bars of the exploration are raised to values of 100 to 200 megavolt amperes, which imposes serious loads on the electric equipment. For this reason, reactance coils were installed

fed from independent stations without permanent coupling between them.

Each exploitation has a high-tension distribution (6 kilovolts) within its confines, either for supplying large consumers equipped with primary motors (compressors, extracting machines, commutators for powering trolley lines, etc.) or to be directed to other surface or underground secondary stations where a low-tension transformation and distribution takes place.

Departures toward the subterranean transformer and distributing stations are achieved through high-tension cables which enter through adjacent galleries or underground pits. The number of entry cables is selected so that there will always be at least two transmission routes and a reserve of at least fifty percent in each section. Where there are pump stations around the pit, the second transmission line enters into the table of the principal water evacuation pumps, which permits coupling with the main underground table.

It must be mentioned that in relation to the position of the strata and thus of the consumption points, the subterranean supply scemes may in principle present two variations (Figure 1).

Figure 1 is applicable to the exploitation of greatly inclined strata (example: E. M. Petrila, Aninoasa), where the mining operations have a somewhat concentrated character and thus the horizontal distances from the pit are relatively small. Here the entire electric power for the underground use is introduced through one pit, with a reserve into a neighboring auxiliary pit, at the base of which a high-tension distribution is then made for the main consumers around the pit (main pumps, commutators, etc.), for the departure of high voltage to the transformer stations of the sector, and finally for the step-down transformers of the smaller consumers around the pit.

Figure 2 is applicable to the exploitation of less inclined strata and thus to a larger horizontal expansion (E. M. Vulcan, Lupeni). Here a 6-kilovolt area network system was created with an extension to a number of kilometers. Entry into the heavy consumer centers is made through regular cables at the sector's transformer stations.

The high-tension network has an insulated zero potential with an over-all tendency to go to 6 kilovolts rather than to 5.5 kilovolts as in the past.

Low-Tension Supply to Underground Consumers: For the working conditions at Jiu Valley it was shown that a tension of 380 volts was sufficient for receptors of less than 200 kilowatts resistance.

In the period when the penetration of the high tension was limited to fresh air zones and to concrete work, a number of low-tension variations were tried out to assure the tension and starting coupling of the larger pieces of equipment in the mechanized areas under the most economical conditions--namely:

Penetration with an intermediate transmission tension of 1,000 volts to 1,000/400 volt transformer stations close to the consumers
Raising the tension of the consumers to 550 volts.

Neither of these solutions has been extended.

It was seen that limiting the extension of high voltage is not justified from a technical, economic, nor an NTS [not identified] point of view as long as all security measures are taken in the construction and assembling of the installations.

Thus today work is carried on almost everywhere with one or several sector-wide transformer stations as close as possible to the forefront (200 to 400 meters), with power transformers in the smallest possible units and not connected in parallel on the secondary.

Such a transformer feeds into the distribution points from the base niche of the excavation or excavation groups.

Illumination was normalized everywhere at 127 volts, as was signaling, with both of them having their own feeding transformers.

Electrification Indices: The development of electrification in the Jiu Valley mines shows an increase in the total and specific consumption of electric power per ton of coal concomitantly with the increase in coal production.

The specific total consumption of power per ton of coal extracted has undergone a pronounced increase during the years of intensive mechanization, reaching a fairly constant figure of 40 kilowatts per ton for the existing level of mechanization.

On the one hand, an attempt is made to reduce specific consumption by a regime of savings and rationalization, and on the other the ever-deeper penetration of mining activities poses increasingly great difficulties in ventilation, evacuation of water, and transportation, which create a tendency toward increasing the specific consumption.

The distribution of electric power consumption per group of consumers can be seen in Figure 3.

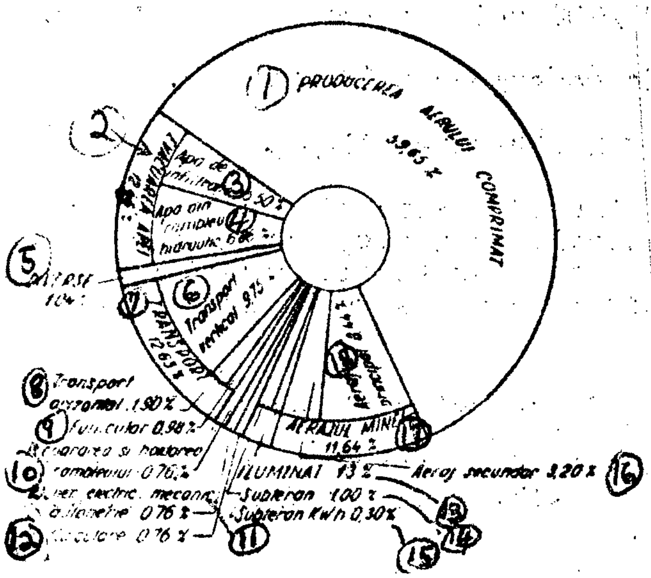

Figure 3. Distribution of Electric Power Consumption in Coal Production According to Principal Consumer Groups

1) Compressed air production, 59.65 percent
2) Water evacuation, 12.46 percent
3) Infiltration of water, 5.5 percent
4) Water from hydraulic filling, 6.86 percent
5) Miscellaneous, 1.04 percent
6) Vertical transportation, 9.75 percent
7) Transportation, 12.63 percent
8) Horizontal transportation, 1.9 percent
9) Funicular, 0.98 percent
10) Preparation and storage of filling material, 0.76 percent
11) Electric and mechanical and carpentry shop, 0.76 percent
12) Circular saw, 0.76 percen

13) Lighting, 1.0 percent; 14) Underground, 1.0 percent; 15) Underground kilowatt hours, 0.3 percent; 16) Secondary ventilation, 3.2 percent; 17) Mining ventilation, 11.64 percent; 18) Main ventilation, 8.44 percent.

The power factor has undergone a continuous increase both in order to be able to better supply the plants themselves and to lower the losses in the networks. Our specifications have also made possible the installation of a series of syn-

chronous machines during 1951-1956, which have raised the power factor by almost 0.8 (Figure 4).

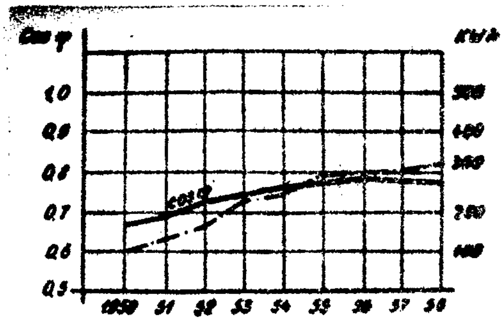

Figure 4. Variation of the Power Factor and Total Power Consumption in the Mining Operations of the Jiu Valley.

An index to the level of electrification is given by the value of the installed specific power of the electric motors per ton of coal extracted daily, namely:

Exploitation	Lonca	Petrila	Aninoasa	Vulcan	Lupeni	Uricani
Specific power, kilowatts per ton	4.9	5.0	5.3	5.5	5.6	3.9
Average index = 5.1						

Pneumatic Power: In mining exploitation in the Jiu Valley pneumatic power occupies an important place in the power balance, representing about 60 percent of the total power consumed in the production process. Though this power is five to eight times more expensive than electric power, its utilization is foreseen in the future also for the following reasons:

It makes for complete safety in mines containing firedamp.
So far it has not been possible to change over to electric powering of the excavating hammers and the perforators for rocks of various hardnesses.
Pneumatic filling cannot be replaced in all cases by hydraulic filling.

The compressed air used in the exploitations of the Jiu Valley is produced at a pressure of 4.5 to 5.0 atmospheres and is distributed at the place of work at 3 to 4 atmospheres. This distribution according to main consumers of compressed air is not the same at all the exploitations, varying between certain limits, as follows:

Excavating hammer, 20 to 25 percent
Perforating hammers, 20 to 30 percent
Pneumatic ventilators, 20 to 25 percent
Various consumers, 5 to 15 percent
Losses, 24 to 30 percent

Within the framework of these various consumers are included sma l pumps, the equipment of the automatic circuit of the pit, the shops, etc.

The specific consumption of compressed air per ton of coal extracted varies between 195 and 220 cubic meters.

For the production of compressed air, piston compressors with two intermediate compressing and cooling steps are used at all exploitations in the Jiu Valley. The compressors are joined with synchronous or asynchronous electric motors. Figure 5 shows the evolution of the installed volume and the specific consumption during 1948-1959.

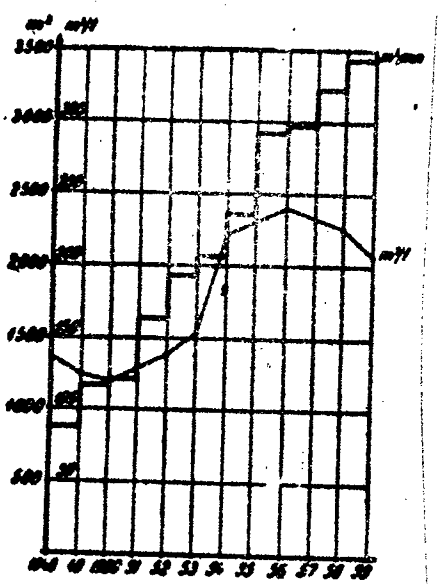

Figure 5. Volume of Installed Compressed Air (cubic meters per minute) and Its Specific Consumption (cubic meters per ton), 1948-1959.

In the past ten years the necessary equipment for the production of compressed air came almost entirely from our machine-building industry.

For a rational exploitation and for the reduction of the cost of pneumatic power, the following improvements must be made:

1) the reduction to the strictly necessary level of the consumers of compressed air;
2) the designing and making of compressors with improved parameters, namely:
   Reduced consumption of electric power per cubic meter of air produced
   Reduced consumption of lubricants
   Improved quality of the materials so as to reduce to a minimum the wear on pneumatic tools

3) Pneumatic power should be transmitted with a minimum of losses through:

- The assembling of underground compressor stations where the transmission distance is greater than 750 meters
- The correct "dimensioning" of the network
- The utilization of valves, bends, and T-shaped fittings with minimal resistance
- The utilization of fittings of superior quality (rubber with fabric insertions, etc.)

Evacuation of Water from the Mine

In the mining works of the Jiu Valley, the water stemming from infiltration is accumulated. Aside from this, in all exploitations except the one at E. M. Uricani, significant quantities of subterranean water stem from hydraulic fillings.

All this water is directed toward the main collector basins and then evacuated to the surface with the aid of mining pumps designed to handle water mixed with sand and clay, which in general have large volumes and back flow.

From the point of view of their construction, the pumps used in our mines may be divided into two groups:

Piston pumps used for secondary mobile stations
Centrifugal pumps used for main stations

In digging the inclined subterranean galleries or enlarging other works for concreting, infiltration water is gathered at the working area and is usually evacuated with small piston pumps. These pumps are mobile and can be moved as the working area progresses.

The piston pumps are in general powered pneumatically, being likely to be used in areas where methane may appear or where the oncoming water may cover them. These pumps have a volume of 6 cubic meters per hour and a compressing pressure of 15 atmospheres, are domestically made (PD-1 type), have a small clearance gauge, and can easily be transported from place to place by two men.

The infiltrating water from the above-mentioned fronts is pushed back by the piston pumps to the collecting canals of the galleries leading to the decanting basins. The filling water also ends up in the same collecting canals, so that all water together flows toward the basins established for the purpose around the pits where the back-flow pipes of the main installations for the evacuation of water are located.

The main stations for the evacuation of water are composed of accumulation basins--usually two(one in operation, the other being cleaned)--a pump room where the pumping aggregates are installed, the suction canals, and the installations for water evacuation proper, including the suction pipes, the centrifugal pumps, and the back-flow pipes.

In the Lonea, Vulcan, Lupeni, and Uricani mining operations, where the water heights are no greater than 200 meters, the back flow from the base level is not directed toward the surface.

In the Petrila and Aninoasa mining operations, the water levels are higher than 400 meters, and in the old stations the back flowing is done in steps. For technical and economic reasons, the new stations are equipped with high-pressure pumps with direct back-flow.

The centrifugal pump types used by us are those manufactured at the "Vasile Roaita" Plants, with a capacity of 18 to 70 cubic meters per hour for small stations, and those manufactured at URUMP with a capacity of 180 cubic meters per hour. For experimental purposes an AIAP-type pump with a capacity of 300 cubic meters per hour and a back-flow height of 600 meters was also imported.

The 180-cubic meter per hour pumps are used for direct back flow to 240 meters high; similarly, the combination of two such pumps driven by a single motor is used to push back water to 480 meters.

These pumps are the most widespread and constitute the basic aggregates for the principal stations for water evacuation in the Jiu Valley basin.

Inasmuch as the volume and especially the back-flow height of the pumps used at present are being surpassed by the current and future requirements of the Petrila and Aninoasa mines, a new type of pump with a capacity of 300 cubic meters per hour and a back-flow height of 600 meters is planned.

The quantities of water evacuated from underground may be established at an average of 1.9 cubic meters of water for each ton of coal extracted.

In the balance sheet of electric power consumption, the evacuation of mine water represents an average consumption of 12.4 percent of the total power consumption of our units.

From the point of view of the safety of underground work, the stations for the evacuation of water consist of groups of pumps in operation, next to which are also installed reserve groups.

To eliminate the danger of the inundation of the pump stations, the pump rooms are built at a level of 0.5 meters above the base of the mine galleries; similarly, the foundations of each pump group have an elevation of 0.5 meters above the base of the room.

Mine Airing

1. The principal airing of all mining operations in the Jiu Valley is by aspiration, achieved with the aid of centrifugal ventilators placed in the stations close to the pits or the air ducts.

In order to prevent breakdown of the main ventilation caused by the wearing out of the ventilators, each station is supplied with a reserve ventilator operating independently from the one in use.

The centrifugal ventilators are of various types, their capacity ranging from 1,000 to 3,500 cubic meters per minute.

The main ventilators, with a capacity from 1,500 to 2,500 cubic meters per minute, are built in the Jiu Valley, and those of higher capacity are imported.

The depressions at which the centrifugal ventilators operate vary between 80 and 200 millimeters of water as a result of mine openings of between 0.8 and 1.2 square meters.

2. The secondary ventilation of the mines in the Jiu Valley is achieved through electrically or pneumatically driven ventilators as well as with the aid of ventilating tubes through which the exhaust air is evacuated from the mining area.

Secondary ventilation is by aspiration in most cases; the combined system is only rarely used.

The tubular ventilator types used for secondary ventilation in the mining operations of the Jui Valley are as follows:

a) The TE 400-1.1 kilowatt electric ventilator with a capacity of 40 to 80 cubic meters per minute at a depression of 60 to 38 millimeters of water;
b) MV 220-6.5 kilowatt electric ventilator with a capacity of 120 to 220 cubic meters per minute at a depression of 130 to 60 millimeters of water;
c) Prohodka 500-2 M-11.4 kilowatt electric ventilator with a capacity of 150 to 250 cubic meters per minute at a depression of 220 to 50 millimeters of water;
d) 300-millimeter diameter pneumatic ventilator with a capacity of 80 cubic meters per minute at a depression of 60 millimeters of water;
e) 400-millimeter diameter pneumatic ventilator with a capacity of 110 cubic meters per minute at a depression of 100 millimeters of water.

With the exception of the Prohodka type, all ventilators are mass-produced in Rumania--the electric ones at Electromotor of Timisoara; the pneumatic ones at "Unio" Works of Satu Mare.

In the past secondary ventilation was generally left to the free diffusion of the air; today the great concern for the working conditions of the miners has led to a great extension of the number of tubular ventilators.

Electric ventilators are widespread, and the pneumatic ventilators are reserved for locations where methane emanations are constant and the rules do not allow the use of electric power.

For ventilation of working areas covering great areas, where at present ventilators in series are used, it is planned to use a new type of ventilator with double depression. The

network of tubes used for secondary ventilators is composed of sheet tubes prepared at URUMP in diameters of 300, 400, and 500 millimeters and lengths of 2,000 millimeters, which are assembled by flanging with cardboard fittings and screws.

The entire main and secondary airing is achieved with an average electric power consumption of 11.4 percent of the total electric power consumed in the Jiu Valley mining units.

Cutting

In the Jiu Valley, the coal and the sterile material in the excavations and galleries are cut mostly by means of explosives. At a small number of working areas where the presence of methane does not allow the use of explosives, the cutting is done with excavating hammers alone. Generally speaking, the hammers are used everywhere, the explosives being used for straightening the front, outlining the galleries, etc., and in the frontal excavation areas about 40 to 50 percent of the front is removed through cutting with an excavation hammer.

All mine holes are perforated mechanically, in most cases with pneumatic drills, but there is a tendency to extend the use of electric perforation in coal. The amount that could be extracted through electric perforation is estimated at about 30 to 40 percent of the total production.

The excavation hammers used in the Jiu Valley (CA-15 type) are manufactured at the "Independenta" Works of Sibiu and have a weight of 15 kilograms, a length of 720 millimeters, and an air consumption of 0.7 to 1.1 cubic meters per minute at 4 atmospheres.

The perforating hammers (CP-19 type) are of the same manufacture, have a weight of 19 kilograms and a length of 500 meters, and an air consumption of 1.6 to 1.8 cubic meters per minute at 4 atmospheres.

The situation with regard to the number of perforating hammers manufactured in Rumania and the number imported is represented in Figure 6.

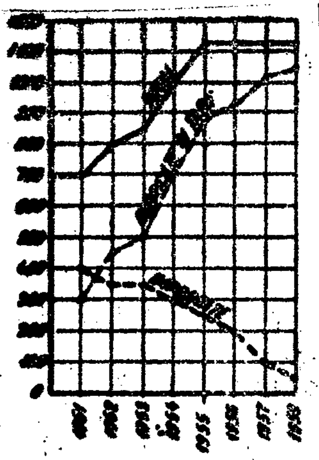

Figure 6. Number of Pneumatic Perforators in Operation in Jiu Valley Mines in Terms of Their Origin

———— Total

—·—·—·— Made in Rumania

- - - - - - Imported

The electric perforators used in the Jiu Valley are of EBR-19 type, of Soviet manufacture, for a 127-volt tension. The manufacture of a similar type in Rumania was realized in 1957; for the current year, the requirements will be covered by our own production.

Percussion perforation is achieved with 7/8" and 1" drills with axial holes made of hexagonal steel pieces. Detachable ends reinforced with hard allow are used only sporadically. For rotating perforation, detachable ends are used, reinforced with hard alloy and with rotating drills.

Undercutting is at present limited to thin strata of small inclination and is only used in themines of Lupeni and Vulcan. The excavators used in the Jiu Valley are driven by electric motors of 40 and 60 kilowatt power.

At E. M. Lupeni, strata 18, 8/9, 5, and 3 were excavated. Stratum 18 was excavated under particularly good conditions, on soft sterile intercalations immediately above the bed. In the 8/9 and 5 strata, the excavation gave less satisfactory results because of the siderite intercalations, and the frontal mining areas of stratum 3 were such that undercutting was not possible. The production extracted through undercutting was not more than 7 percent of the total, remaining at approximately 2 to 3 percent. For the same reasons (siderite intercalations), the cutting with the Dombass-1 Combine was not successful in stratum 8 either at Lupeni or Vulcan.

In the future we shall have to insist on undercutting in the strata without siderite intercalations, importing for experimental purposes undercutters having characteristics superior to those currently used in the Jiu Valley.

Similarly, to increase the speed of digging the galleries, we must import for experimental purposes advancing undercutters with pneumatic action, using them especially where methane emanations make explosions impossible.

For cutting in the type of mining where it would be impossible to undercut because of the intercalations, the use of "coal plows" would have to be tested. Such a plow was planned and made in the Jiu Valley and is to be tested in a frontal mining area. The working principle of this plow has at its basis the vibrations produced by unbalanced masses, activated by an electric motor.

For the mechanization of the digging of service shafts and deep holes in the coal strata, the Soviet-built SBM-3 type of machine is used. The machine is especially designed for drilling service shafts in coal strata or other soft rocks. The holes are drilled with a "hoe", in seven steps from the bottom up, and have a diameter of 390 millimeters. The hole is enlarged to a diameter of 850 millimeters after it is pierced, from top to bottom, also with a hoe and in seven steps.

Deep holes are drilled underground for exploratory or research purposes with special installations of the following types: Kraelius, KAM-300, KAM-500, and by a type recently manufactured at the "Independenta" Works of Sibiu, which is used experimentally at E. M. Uricani.

Generally, these installations drill holes with diameters between 75 and 114 millimeters, with 35/45 millimeter bits. The maximum drilling depth varies between 70 and 120 meters, with an average advancing rate of 0.5 meters per hour.

Loading

With respect to the characteristics of mining work, we shall separate the problems of mechanical loading into two groups: loading in galleries and pits, and loading in excavating areas.

Loading in Galleries and Pits: In accordance with the conditions requiring the loading of rocks after cutting, a series of types of loading machines were used. Of the types of loading machines equipped with mechanical tongues, the pneumatic

PML-5 and the electric EEM-1 Soviet machines were used. The first ones have a suitable clearance gauge; however, they did not give good results because of the impossibility of feeding them with compressed air at a pressure of 5 to 6 atmospheres. The electrical ones were unsuitable because of the large clearance gauge, the frequent breakdowns of the electric control, and the frequent breaking of the chains.

Also for loading in the galleries, the S-153 type of loading machines with scrapers and arms were used. This machine has not given good results either, because the construction of the chain is such that it cannot exert the effort required when stone granules are interposed between the chain links and the activating "star."

Because of the unsatisfactory results obtained with the above-mentioned machines, rubber belt loaders were designed and made in the Jiu Valley (Figure 7) for reducing the physical effort of the loader by lowering the shoveling height. Following the satisfactory results obtained with these loaders, they have been extended to all mines in the Jiu Valley.

Mechanical loading at the pits during digging is achieved with B C-1 type grab buckets of Soviet manufacture. The results obtained are satisfactory and therefore their use will be continued in the future.

For the mechanization of loading in the galleries, UKE-03 type loading machines with tongues, electrically powered and with clearance gauges suited to our conditions should be imported for experimental purposes.

Loading in Excavating Areas: In the mines of the Jiu Valley, coal is usually extracted by the method of frontal and chamber type mining, the latter accounting for approximately 65 percent of the total production. In both frontal and chamber mining, loading is partially carried out by direct dropping on the transport vehicles following blasting, and the rest is loaded manually either by pulling with a hoe or by shoveling. Keeping in mind the fact that in frontal mining transportation takes place along the entire front, direct loading is favored and reaches a higher percentage than in chamber mining.

It is therefore judicious that in frontal mining the current vehicles be replaced with armored ones which will permit the blasting of the coal directly into them. Thus the problem

of loading by the direct dropping method would take care of approximately 70 percent, with the rest to be loaded manually. The solution of the problem in the form shown above will go in parallel with the perfecting of metallic armatures having poles articulated in consoles.

The problem of loading the coal in chamber mining is more complex and cannot be solved satisfactorily by direct blasting, as the transport vehicle is perpendicular to the work front. In this case it is necessary to load the coal onto the vehicle with the aid of a machine. The building of such a machine is conditions by a series of factors:

The very small space available for maneuvering
The nonhomogeneous granulation of the coal
The uneven floor of the mining area after blasting

Keeping in mind the above factors, the machine must be simple, light, have great mobility, and sure operation--these conditions being particularly difficult to satisfy in spite of the efforts of the workers, technicians, and engineers in the Jiu Valley, who have conceived and made almost 20 types of such machines, although they have been unable to find a definitive solution. We must mention that the later types of machines, among these the disk loader (Figure 8), the chain and hoe machine (Figure 9), and the machine with loading arms (Figure 10), gave promising results in initial tests but could not be employed in the normal exploitation process, and for that reason the problem has remained unsolved in its final form. The importation of the Soviet GNL-30 type machine, which is similar to the S-153 machine with a smaller clearance gauge--a machine giving satisfactory results when loading in chamber mining--must be mentioned.

Filling Installations

The mining exploitations in the Jiu Valley involve rock filling (rambleiera) to a very large extent. Of the total production of coal, about 12 percent is taken out through an exploitation method that includes filling, utilizing both total filling and partial filling. The aim of filling is to prevent mine fires, drainage, and in special cases for the protection of the surface area and of the respective buildings.

The filling procedures used in the Jiu Valley are:

Hydraulic filling, about 86 percent of the total
Pneumatic filling, about 11 percent of the total
Manual filling, about 3 percent of the total

Thus the hydraulic procedure obviously is of great importance in filling and is widespread throughout all mines and exploitations in the Jiu Valley (with the exception of E. M. Uricani); pneumatic fillig is used only at E. M. Lupeni, and manual filling is used sporadicalky in all mining exploitations.

The material used for filling is usually the sterile material from underground excavations (marl, sandstone).

The sterile material to be used as filling is prepared in special installations. The old imported installations are used in the Jiu Valley and recently a filling installation manufactured in Rumania was placed into operation at E. M. Aninoasa.

The granulation of the prepared material varies between zero and 40 millimeters; in the case of pneumatic filling, very small material of 0 to 5 millimeters is eliminated. The prepared material is transported to the edges of the filling area in small wagons or funiculars, the content of the wagons being emptied directly into special silos for filling material.

The Hydraulic Filler: As mentioned, hydraulic filling is used in the great majority of the mining exploitations in the Jiu Valley. The filling gratings for hydraulic filling are placed near the pits or airshafts. The distance over which the filling material is transported varies between 300 and 1,000 meters, working with a pressure of 15 to 30 atmospheres. Water consumption varies between 4 and 10 cubic meters per cubic meter of solid material, giving 200 to 250 cubic inches of filling per grating per day. Figure 11 shows diagrammatically a hydrauling filling grating. The material from the silo is measured into the mixing grating through a register; the water-material mixture is mixed in the grating and flows through a pipe. The water required for filling is kept in reservoirs or retaining ditches channeling all water toward them. Sometimes it is necessary to pump the water required for filling over long distances or to recycle it.

Pneumatic Filling: At present, the only exploitation in the Jiu Valley using pneumatic filling is the E. M. Lupeni.

The machines used for filling are pneumatically driven, automatic Torkret type, and are imported.

Figure 12 shows a diagram of the pneumatic filling installation at E. M. Lupeni, 650 to 565 meters in horizontal length. The filling material is brought from the preparing installations in small wagon trains. The material is mexed in the silo and from there directed toward the working machines. The compressed air needed is obtained from a compressing station set up in the vicinity, which is equipped with three 3-V-45/7 type compressors manufactured at the C. C. Resita. Two machines work alternately. The maximum distance to which the filling is transported ia bout 500 meters.

The specific consumption of compressed air varies between 120 and 150 cubic meters per cubic meter of filling, and the absolute consumption between 45 and 90 cubic meters per minute. The maximum filled at this station has never been greater than 200 cubic meters per day--usually between 100 and 150 cubic meters per day.

Pipes: For the transportation of filling material in the Kiu Valley, pipes with an internal diameter of 150 millimeters and a wall thickness of 6 to 8 millimeters are used. The length of the pipes is 4 meters; light pipes 2 to 3 meters long made of sheet metal are also used. The resistance of the pipe material varies between 40 and 50 kilograms per square millimeter; the pipes can handle the transportation of 8,000 to 10,000 cubic meters of filling. In the last three to four years an attempt was made to use boring poles as pipes for filling material, which gave somewhat better results because the resistance of the material of which these poles are made reaches values of 60 to 65 kilograms per square millimeter and the wall thickness is about 10 millimeters.

For the detouring of the pipes, cast steel elbow joints of various angles are used; their resistance in use does not always correspond to the task.

Keeping in mind that lately, because of exploitation difficulties, filling has become more and more important, and since it is necessary to extend pneumatic filling at the E. M. Aninoasa, set up new filling stations at the E. M. Lupeni, and increase the volume of hydraulic filling along the entire

Jiu Valley, urgent measures must be taken for improving the quality of the domestically manufactured equipment of the installations for the preparation of filling material.

Simiarly, the domestic manufacture of filling machines will have to be put in order. A problem remaining unsolved is that of the filling pipes. Neither the pipes nor the boring poles correspond to the tasks and wear our prematurely. The problem of increasing the resistance of the tubes by treating (tempering) the interior surfaces of the tubes or by lining them with basalt will have to be investigated, at the same time examining the possibility of importing steel tubes with a high content of manganese, which are resistant to wear.

Underground Transportation

The nature of the work and the mining conditions in the Jiu Valley operations require that a large volume of transportation be carried out underground, with the aid of complex equipment and installations.

A large number of drag conveyors [conveyors with scrapers (racleta)], coal transport wagonettes, small cars for the transport of wood, switching trolleys, locomotives with various characteristics to suit the tracks on which they run, chains for offsetting differences in level, brakes, installations for pushing wagonettes, extracting installations, as well as small related pieces of equipment constitute the foundation of underground transportation in the mines of the Jiu Valley.

To a large extent this mass of equipment and transportation installations is composed fo standardized units, thus facilitating repairs and the supply with interchangeable parts.

The main task of underground transportation is to transport coal from the excavating areas to the surface of the mine.

In the chamber type excavating areas, the use of light drag conveyors is generalized. Chamber excavating areas in zones with excessive layering and great pressure, where the transportation is carried out in small wagons, are very few.

In the horizontal frontal excavating areas and in those with a slight inclination, coal is transported with medium-weight drag conveyors.

The coal in the frontal mining areas with extreme inclination and in those with twisted steps is transported by free fall to the lower level galleries, where it is taken up by the drag conveyors and brought to the collecting areas.

In connection with the transportation of coal from the excavating areas, it must be especially mentioned that in the 1938-1958 period the number of drag conveyors increased 7.8 times. This fact indicates the extent of the large-scale transition from manual transportation to mechanized transportation (Figure 13).

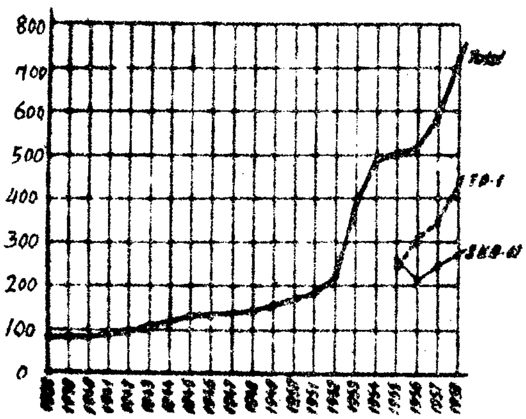

Figure 13. Increase in the Number of Drag Conveyors, 1938-1958

Concomitantly with the large-scale extension of drag conveyors, oscillating pneumatic conveyors (scoc) having a low yield were abandoned.

At the end of 1958 the total percentage figure for the mechanization of transportation in the mining areas of the Jiu Valley exploitations reached 83.6 percent.

Coal is transported in the galleries exclusively with 1,000-liter wagonettes, which are drawn by electric trolleys or locomotives.

The volume of the wagonettes has increased in the last few years, concomitantly with an increase in production; important improvements in construction were also made in the type of wagonettes used.

Compared with the actual production of our mining units, and taking into account the number of wagonettes being repaired, a rolling coefficient of close to 1.0 is achieved, corresponding to the average distances of transportation in the Jiu Valley mines.

The maneuvering and traction of the wagonettes by means of trolleys and locomotives in the main and secondary galleries

on inclined territory and in pits reached a mechanization of 97.6 percent in 1958.

Technical and economic considerations have necessitated the use of trolley locomotives in all main galleries having fresh air circulation, where all measures are taken to prevent the appearance of methane gas.

Locomotives with accumulators were greatly extended underground, carrying out transportation in the secondary galleries where there is a possibility of methane gas appearing.

Internal combustion locomotives are used in the main and secondary galleries where conditions of intense ventilation assure the removal of exhaust fumes.

The numerical increase in the types of locomotives is shown in Figure 14. Figure 15 shows the increase in the number of locomotives with accumulators according to their weight.

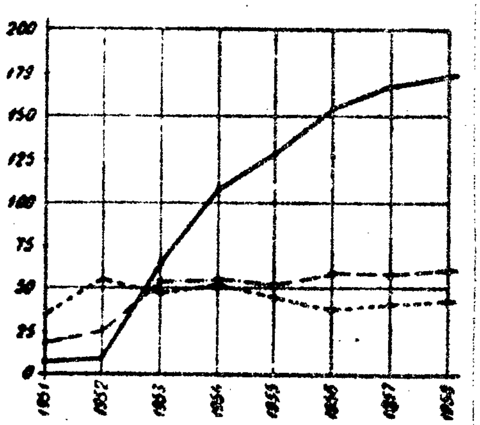

Figure 14. Increase in the Number of Mine Locomotives, 1951-1958

——— locomotives with accumulators

------- internal combustion locomotives

-·-·-·- trolley locomotives

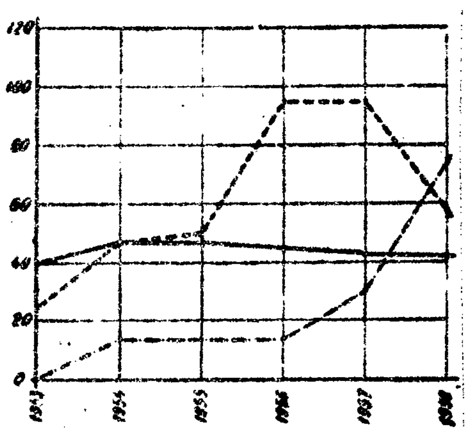

Figure 15. Increase in the Number of Electric Locomotives with Accumulators in the Jiu Valley, 1953-1958

——— locomotives with accumulators (2 tons)

----- locomotives with accumulators (4 tons)

-·-·-· locomotives with accumulators (6 tons)

The trolleys used are frequently 22-kilowatt ones with one or two drums (toab) for traction on inclined planes, 12- and 5.5-kilowatt ones for maneuvering in galleries under heaps of material and in pit ramps, and 3-horsepower pneumatic trolleys for the transport of material--especially wood--through shafts.

In the level-compensating plane of the pit circuit, traction with elevating chains is used, and mechanical pushers with chains or cables are used for pushing the wagonettes around bends.

It is important to note that all types of transport equipment used underground were introduced wholly by our machine-building plants and are mass produced.

In blind pits, coal is generally transported by raising or lowering it to the main horizontal base level, where the entire production is concentrated.

The extraction installations in the main pits lift the extracted coal from the base level to the surface.

The extension during the last few years of the existing mines and the opening up of new ones led to an increase in the number of extracting machines as well as in the installed power for servicing the pits in the Jiu Valley mines. The increase in the number of extracting machines used for vertical transportation from 1949 to 1959 is shown in Figure 16.

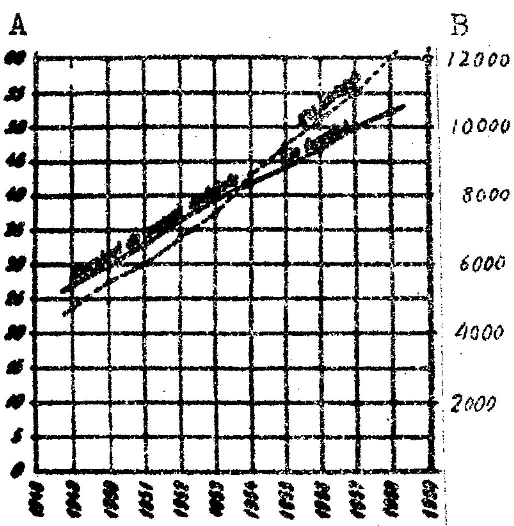

Figure 16. Increase in the Number of Extracting Machines (A) and Their Installed Power (B) in the Jiu Valley

The high-power machines servicing the principal pits are driven by direct-current motors fed from converter groups. The motors of the machines are coupled directly to the axles of the folding parts of the cable, thus offering the possibility of varying the extracting speed without loss of power.

The low-power machines are driven by asynchronous motors fed from the network, with cog-wheel speed reducers interposed between their axle and the axle of the folding parts of the cable.

The great majority of the extracting installations have cylindrical drums, and only two are supplied with friction wheels (koepe).

The drum machines are used in the pits servicing several levels, one of the drums being detachable from the axles.

The moving masses in these machines are larger than in the machines with friction wheels. In the main pits, where production is concentrated on a single base level, the extraction with friction wheels is advantageous. This is the case at E. M. Petrila and E. M. Aninoasa.

At present the standard types of small machines built in Rumania are being improved and modernized.

The machines for large-scale extraction are imported from the USSR, Hungary, and Czechoslovakia.

Mechanization on the Surface of the Mines

On the surface of the mines a series of operations are carried out to ensure the unfolding of the production process under normal conditions. Generally, the activity on the surface of the mines consists of the following:

Transportation, storage, and transferring of coal for preparation
Transportation and storage of sterile material
Unloading, storage and transportation of mine timbers
Unloading, storage, and transport of equipment and material

The wagonettes carrying coal and sterile material enter the surface area automatic circuits and then leave on different roads.

The coal is directed toward the dumping devices, from where it is stored with rubber strips (benza). The empty wagonettes are returned to the pit for rerouting to the underground areas.

The sterile material is directed toward the sterile silos, where part of it is used in the preparation of filling material and the rest is stored in slag heaps with the aid of funiculars or by the direct dumping of the wagonettes. The funicular "cups" are automatically emptied over the desired spot.

The automatic circuits, which consist of inclined railway lines assuring the free rolling of the wagonettes, have installations for stopping, brakes, dumping devices, lifting chains, installations for cleaning the wagonettes, and installations for loading at an angle.

The mining timber is brought by freight car to the unloading areas, where it is unloaded and stored in stacks. From the stacks it is loaded into special cars for transportation underground, these cars entering into the circuit of empty wagonettes. In the Petrila mine a mechanical installation was established for unloading the wood from the freight cars, on the principle of a portable crane (Figure 17), which is to be placed into operation to facilitate the heavy job of manual unloading and to increase the productivity of labor.

The materials and equipment are unloaded at storage places, from where they are transpor ed as needed to the working areas on the surface or underground.

We may mention that in the electric plants at Vulcan and Petrosani mechanical installations were completed lately, as follows: at the Vulcan electric plant, a complex installation for unloading coal directly from the CFR [Rumanian Railways] freight cars (Figure 18) was completed; and at the Petrosani electric plant the operation for evacuating waste matter by water jets was mechanized.

Captions of Figures Not Reproduced

Figure 1. Distribution of Electic Power for Greatly Inclined Strata.

Figure 2. Distribution of Electric Power for Slightly Inclined Strata.

Figure 7. BIBM-type Rubber Belt Loader.

Figure 8. Disk-Loading Machine.

Figure 9. Loading Machine with Chains and Hoes.

Figure 10. Loading Machine with Arms.

Figure 11. Diagram of the Hydraulic Filling Station at E. M. Lupeni.

Figure 12. Diagram of the 565- to 650-meter Horizontal Pneumatic Filling Station at E. M. Lupeni.

Figure 17. Crane for Unloading Timber from Freight Cars in the Petrila Mine Storage Area.

Figure 18. Installation for Unloading Coal from Freight Cars at the Vulcan Electric Plant.

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